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ECONOMIC GEOGRAPHY

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Clifford M. Zierer

GEOGRAPHY OF THE UNITED STATES COTTONSEED OIL INDUSTRY
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A RECONNAISSANCE OF SOME CULTURAL-AGRICULTURAL ISLANDS IN THE SOUTH
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THE OILS

IN the changing program of world trade and world economy, the oils play an ever increasing and ever interesting part. As food, as fuel, as luminant, as lubricant, as essential elements in a multitude of minor and major uses, they have become indispensable commodities to all peoples, important factors in the world's progress. They aggregate millions of tons in annual production and trade, millons of dollars in value.

The animal oils—butter, tallow, and suet; whale oil, shark oil, and fish oil—were first important in man's economy. The vegetable oils—palm oil, olive oil, linseed oil, cottonseed oil, soybean oil, and a score of others have long served man's many needs. The most important of all in quantity of output and significance of effect upon civilization, has probably been petroleum, with its vast yield of power and lubricant for the age of mechanized industry.

Peace and prosperity, health and welfare of nations have depended upon availability of these oils and fats. Wars have been won by abundance of oil, wars have been lost because of its lack. The wheels of progress have kept going by the power and lubrication the oils afford. The homes and offices, the bridges and docks, the fences and furniture of folk the world over have been kept in condition by pigment suffused in oil. The comfort and strength of the world's peoples have been partially insured by oil for food and light.

The oils are as necessary to man's culture as are metals, or soil, or sunlight, or water. With them he progresses; without them he fails and perishes.

ECONOMIC GEOGRAPHY

VOL. 17 OCTOBER, 1941 No. 4

BRISBANE—RIVER METROPOLIS OF QUEENSLAND

Clifford M. Zierer

MUCH controversy has taken place in Australia in respect to the notable concentration of urban activities and services in the capital cities of the several states. Many rural residents are of the opinion that much urban development is parasitic and residents of provincial cities and towns believe that the metropolitan centers have robbed them of just shares of commerce and industry.

Although it may appear that "many ports have been created in Queensland to serve the state while elsewhere in Australia the states have been designed to benefit their capital cities," the fact remains that Brisbane has developed into the only outstanding urban center of that extensive semitropical realm. Other centers of population, widely spaced along a 3,000-mile coast line, perform collective and distributive functions for their respective hinterlands but all parts of the state look to Brisbane for important governmental, business, and cultural services. Despite its non-axial location, Brisbane stands pre-eminent among the urban agglomerations of Queensland and analogous in most respects with other metropolitan centers of that continent.

ORIGIN OF BRISBANE

Brisbane had its origin, like Newcastle, Hobart, and numerous other Australian cities, in the British policy of establishing branch penal settlements to relieve congestion at Sydney. In 1823, Governor Brisbane sent an expedition under John Oxley to search the coast beyond Port Macquarie for a site where a new convict station might be established. Oxley first examined Port Curtis but was not impressed by it despite the advantages of the site later to be recognized by some as superior to those at Moreton Bay. He returned south to the Moreton Bay district and landed on Bribie Island which forms the northern margin of the bay (Figure 1). Later he examined the vicinity of Redcliffe, on the mainland within the bay, where supplies of water, soil, and timber seemed ample. Then proceeding up the Brisbane River he was impressed by the beauty and fertility of its banks as well as by its "navigability." Particular attention was called to the excellent timber available in large quantities about Moreton Bay. A favorable report in Sydney led to the dispatch of a group of prisoners and soldiers to Moreton Bay in the following year.

FIGURE 1.—General location map to show the relation of Brisbane to Moreton Bay, to the watershed of the Brisbane River, to significant mountain ranges, and to neighboring districts.

Oxley accompanied the party northward and established the settlement near Redcliffe Point. The site, however, soon came to be regarded as unhealthful due to the poor drainage of the coastal margin. Further exploration of the Brisbane River led Oxley to recommend removal of the party to the site of Brisbane by the close of 1824 (Figure 2).

Oxley's removal to Brisbane, however, was not wholly unchallenged. Serious objection was made by Governor Darling (successor to Governor Brisbane) and others because of "the tediousness and difficulty of the access." A site six miles downstream at Eagle Farm, where some convicts were assigned to farm duties, was urged with considerable justification. Others proposed that the settlement be removed to the inner margin of Stradbroke Island, which has since proved suitable only for a benevolent asylum and a small aboriginal settlement.

The site of Brisbane lay about fourteen miles upstream and on somewhat higher ground through which the river flowed in a series of tortuous meanders. The site afforded ample drainage, a small stream of fresh water, good supplies of timber and stone, nearby patches of cultivable soil, and suitable landing places. Buildings were scattered about in the open woodland, and irregularly spaced roadways connected the several portions of the settlement. The nearest approach to a formal town pattern occurred in the lines of buildings near the river bank adjacent to the wharf. Winding tracks through the woodland provided contact with outlying patches of land under cultivation.

The early Brisbane was concerned only with maintenance of a penal establishment. The principal events in the life of the community dealt with "the arrival of a new commandant, a fresh contingent of soldiers, or just another batch of prisoners." In 1831, Brisbane contained 1,241 persons of whom 1,066 were convicts. Free settlers were prohibited within a 50-mile radius by governmental decree. In 1839, Brisbane officially ceased to be a penal settlement, and free settlers were admitted in 1842, following public land sales held in Sydney.

In 1840, the town pattern of Brisbane was formally established by government surveyors. The main axes of the temporary penal establishment became the fixed pattern of the new free settlement. Thus Queen Street grew out of the roadway connecting the two landings on opposite sides of the meander. Its continuation to the northeast along Wickham Street followed the lowland track to farm lands at Breakfast Creek and Eagle Farm several miles downstream. William Street followed the rows of convict buildings paralleling the river bank (Figure 3). The termination of the main road from Ipswich at wharves opposite those of the early penal settlement, emphasized the importance of that river crossing (now

Victoria Bridge) in the urban structure. Later surveys fixed upon the site many other forms casually outlined in the early years of occupation.

Official attitudes likewise placed their impress indelibly upon the Brisbane site. Being a part of New South Wales, officials in Sydney looked upon Brisbane as "just another country center." As a result, streets were limited in width to one chain (66 feet) and no attempt was made to create a distinctive city pattern such as was provided in some of the later capitals. In consequence, Brisbane lacks important street vistas and public squares, and considerable traffic and residential congestion have resulted from short-sighted subdivisions.

Outlet for Darling Downs

The most important factor in the early growth of Brisbane as a free colony was the occupation of the Darling Downs and lands along the upper Brisbane River and its tributaries (Figure 1). Occupation of those lands by pastoralists took place overland from New South Wales even before the discontinuance of convictism permitted entrance through the Brisbane gateway. In fact, it was in large part the clamoring of the pastoralists for a more satisfactory outlet to seaboard for their products which brought about the early conversion of Brisbane into a free settlement.

Wool was brought from the interior by bullock wagon to the head of navigation for river boats at Ipswich for dispatch to Moreton Bay. Ipswich thus established itself as an important trading center for the Darling Downs in competition with Brisbane. Early attention had also been drawn to the Ipswich district because of the avail-

FIGURE 2.—The general arrangement of urban development along the lower Brisbane River. The approximate limits of urban expansion in Brisbane and in satellite towns are shown. The independent character of city growth at Ipswich is due largely to the presence of coal.

ability there of coal and limestone. Navigation difficulties on the river, however, soon caused wool to be hauled to Brisbane, or even to Moreton Bay, for transfer to boats. In an effort to regain her trade Ipswich obtained railway connections with the Darling Downs as early as 1867 but the line was extended to Brisbane in 1875. (Much detailed information about the growth of Brisbane is contained in the following: Craig, W. W.: *Brisbane Centenary History*, Brisbane, 1924; and Barton, E. J. T.: *Jubilee History of Queensland* [Brisbane] 1909.)

Since much produce from the interior came to Brisbane by winding country road to a point on the south side of the river and opposite the settlement, it was to be expected that a rival suburb should arise (Figure 3). South Brisbane was officially surveyed and opened for occupation in 1842. In 1846 Brisbane had 483 people and South Brisbane had 346 inhabitants. A ferry connected the two settlements and later (1865) a bridge was constructed on the site of the present important Victoria Bridge. South Brisbane occupied lowlands which earlier had been cultivated by convicts and which suffered severe inundation during floods. Considerable activity also centered on Kangaroo Point in connection with the handling of produce

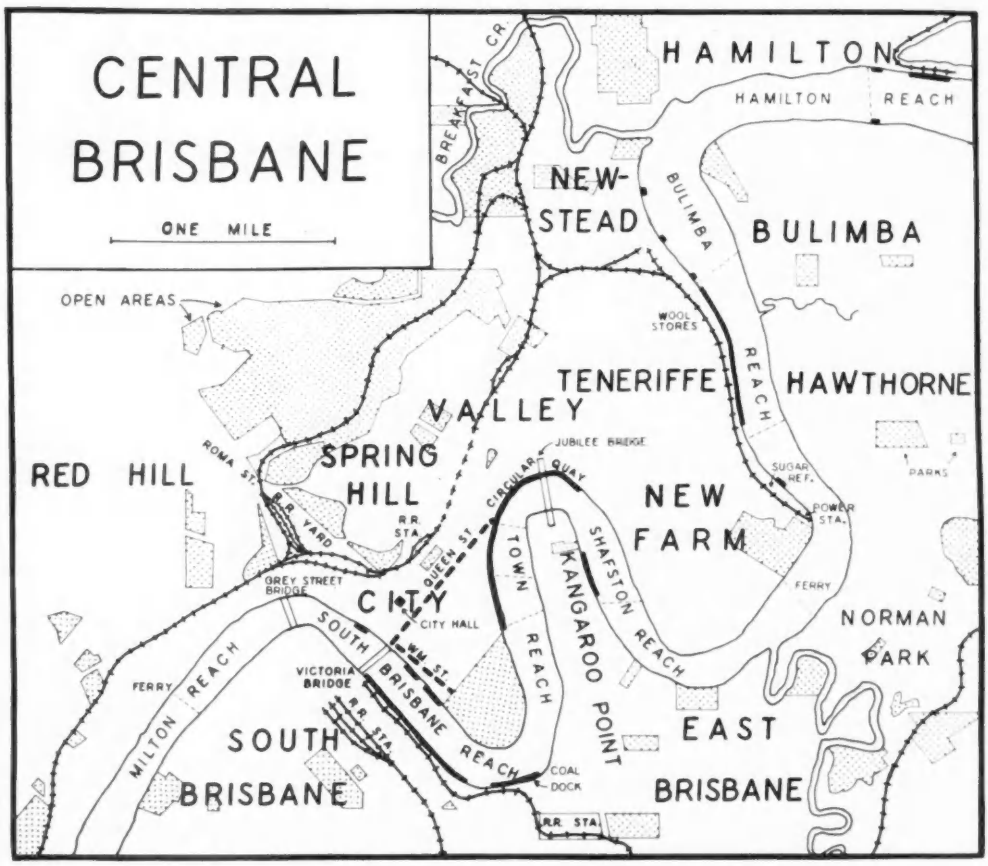

FIGURE 3.—Principal elements of the central portion of Brisbane. The names of local municipalities, essential railway and river development, public park and reserve lands, and the principal axes of street pattern in the central core.

FIGURE 4.—The small wharf at Pinkenba near the entrance to the Brisbane River. The freighter in midstream is heading out to sea. Mangroves border the river in most places along the lower channel.

from the interior. The somewhat easier access to South Brisbane wharves, however, led to the gradual decadence of the alternative south bank depot.

Pastoralists continually objected to Brisbane as a port of outlet because of the unreliability of even the lower river for navigation. A deep water port was sought at Cleveland or elsewhere on Moreton Bay (Figure 2). Although the difficulty of reaching the Brisbane site by overseas vessels was early recognized, the alternative sites for a port city on the bay had little to recommend them. Innumerable shoals in Moreton Bay and extensive marshes covering the coastal margins provided serious handicaps for extensive port and urban development.

BRISBANE CHOSEN AS CAPITAL CITY

For nearly two decades following the arrival of settlers in Brisbane there was much discussion of the creation of a separate state because of the great distance from the seat of government at Sydney. Strong rivalry arose among Brisbane, Ipswich, and Cleveland for selection as the capital of the proposed state (Figure 2). Finally, in 1859, Queensland was constituted a separate state, and Brisbane with a reputed population of 5,000 was named the capital city. Its rapid development as an administrative and commercial center was thenceforth assured. (The growth of Brisbane during successive decades is shown as follows: 1861—8,000; 1871—23,000; 1881—47,000; 1891—104,000; 1901—123,000; 1911—145,000; 1923—236,000; 1933—300,000.)

BRISBANE'S STRUCTURAL PATTERN

Brisbane might have possessed a more elaborate urban pattern. A first design provided broad streets and avenues with ample open spaces. A special feature consisted of an esplanade extending along the river front for several miles. However, authorities in Sydney believed that "it was utterly absurd to lay out a design for a great city in a place which in the very nature of things could never be more than a village." The Spring Hill district, just northwest of the principal commercial core, afforded an opportunity for an acropolis but instead it now contains a maze of narrow streets and alleys (Figure 3). In spite of certain deficiencies Brisbane has a distinctive form because the site made a variety of adaptations desirable. Brisbane is commonly referred to as "the city of hills" and as "the river city," both characterizations reflecting important and unique features of its pattern.

Brisbane is situated on slightly higher ground at the inner margin of the narrow coastal lowland (Figure 1). The city is backed by a series of irregularly distributed and forested coast ranges (chief of which is the D'Aguilar Range) through which the river has carved its course. Scattered and rounded hills, ranging in height up to 250 feet, projecting upland spurs, and intervening lowlands cut by the meandering river and its smaller tributaries comprise the urban site. In many portions of the city the street pattern is closely adjusted to steep hill slopes and to

escarpment edges overlooking the river. To the west, city expansion is blocked by an isolated ridge segment (Mt. Coot-tha) which attains an elevation of over 900 feet and provides a rugged park area five miles west of the central city (Figure 2). Some residential development has spread upon the lower margins of that upland to capitalize the views overlooking the city.

Urban development in the direction of Ipswich is oriented upon the major highway and railway route which sought to avoid the widespread meanders of the river as well as the edges of the upland through which the river carved its course (Figure 2). Between Brisbane and Moreton Bay are broad stretches of wet coastal plain with occasional tongues of dry land giving access to small sections of slightly elevated shoreline. Road patterns on the coastal plain are generally rectangular, but a radial pattern is superimposed to give quicker and more convenient access to important outlying places. Winding sloughs and shallow bodies of water commonly interrupt the road pattern in the coastal belt.

The Brisbane River also gives distinctive character to the city site (Figure 2). It not only affords access from the sea but its meandering course provides a second major cause for deviation from an attempted rectangular urban pattern. Within the city area are ten peninsular tracts, partially enclosed by river meanders, in which street patterns are generally adjusted to the axes of the peninsulas. A comparative degree of isolation is experienced in many such tracts which are locally called "pockets." Since only four bridge crossings are available between the two more or less equally divided parts of the city, the barrier effect of the river is readily visualized. Transfer of goods between the principal railway terminal in South Brisbane and that in Brisbane proper (less than a mile apart by street) involves sixteen miles of haul over the Indooroopilly railway bridge near the southwest corner of the city. Ten or more passenger and vehicular ferries supplement the bridges in providing contact between the halves of the city (Figure 3). Dead-end streets along the river greatly inconvenience the flow of traffic. Residential development in some of the eastern suburbs has clearly been handicapped by the slowness and inconvenience of access to those parts from the central city. Bridges and ferries are responsible for marked concentrations of traffic along certain streets and at the few river crossings. The need for additional bridges is generally recognized.

A third cause for interruptions in street pattern is the division of the Brisbane metropolitan area into more than a score of independent cities, municipalities, and shires. Each unit was laid out to meet local conditions and little correlation was provided with adjoining units. Similarly when individually-owned tracts of land were subdivided street patterns often failed to join those already established. In consequence no other large city in Australia presents as great problems in internal circulation unless it be Sydney.

Important official recognition of the unity of the geographic city took place in 1925 when twenty independent governmental areas were coalesced to form a single municipal unit covering 385 square miles. An area within an approximate ten-mile radius of the central city is included but Ipswich lies outside despite its close association with the economic life of Brisbane. That important step in the direction of local government simplification came as a result of the need for closer coöperation among all parts of the geographic city

in planning for highway improvements, bridge construction, water supply, sewage disposal, recreation areas, and other needs.

As in many other cities subdivision has taken place on all sides of Brisbane in excess of current needs. Scattered homes, unimproved streets, inadequate provision for utilities and decadent agriculture characterize that encircling belt of transition in land use.

NAVIGATION OF BRISBANE RIVER

The development of Brisbane always has been intimately related to its river. During the convict period (1824–1839) Brisbane was served by small schooners and cutters able to enter the river and bringing government stores from Sydney. Immediately following the entrance of settlers small vessels began calling with stocks of general merchandise to be exchanged for wool, tallow, hides, and skins. A four-foot tree trunk paralleling the stream margin served as an early wharf. More suitable wharves were constructed in Brisbane and South Brisbane by 1845. The large amounts of wool, hides, and tallow, assembled at Brisbane led to the appearance of larger vessels in Moreton Bay during the 1850's. Unable to pass over the nine-foot bar at the river mouth those vessels anchored in the bay and took on their cargoes from lighters.

Moreton Bay includes about 750 square miles and is filled with islands and shoals (Figure 2). The passage between Bribie and Moreton islands affords the only safe entrance for vessels. Deep water is seldom found along shore which fact makes the provision of ocean shipping facilities on the bay front most difficult. Despite its handicaps the Brisbane River was early judged to offer the most satisfactory solution to the shipping problem and the dredging of its channel was recognized as an essential to city growth.

During the 1880's a 15-foot channel was cut through the diorite reef at the entrance to the river and in addition the channel to Brisbane was straightened and deepened. By 1900, a depth of 20 feet was available to the city, and by 1906 it was dredged to 24 feet. Dredging is in progress to provide a depth of 30 feet to Hamilton and Teneriffe in order to accommodate modern vessels (Figure 3). The dredged channel width also has been increased by stages from 100 to 400 feet.

FIGURE 5.—Circular Quay is composed of the principal wharves bordering the main wholesale and retail district of the central city. The largest overseas freighters are unable to approach these long established docks because of inadequate river depth. The conspicuous tower of the City Hall from which excellent panoramas of the city may be viewed is shown. The foundation of the new Jubilee Bridge reaching across to Kangaroo Point is in the right foreground.

The greater natural width of the river below the city encourages silting in the lower reaches by diminishing the rate of current flow. The flood of 1893 filled up most of the dredged channel and practically isolated the city. In consequence a system of training walls (10 feet in height above low-water level) was commenced in 1897 at Hamilton to constrict the lower river. By 1906 most of the lower river was bordered by training walls behind which it was possible to deposit dredgings thus creat-

ing desirable waterfront sites for docks, warehouses, and industrial plants.

Another river problem at Brisbane was that of maneuvering vessels about several sharp bends in the original channel. By means of extensive quarrying operations on both the inner and outer sides of those bends, curvatures have been increased to accommodate modern vessels. Rock obtained from widening operations was used to construct the training walls to narrow the river a few miles below. River improvement at Brisbane has amounted essentially to dredging a "canal" 14 miles in length, and, furthermore, the channel is in need of periodic excavation because of continuous silting.

Due to the steady increase in size of vessels and in acknowledgment of the difficulty of maintaining adequate depths for shipping, the river is now divided into three principal sections for navigation. Overseas vessels normally berth only in the lower river, as at Pinkenba, Hamilton, and Bulimba (Teneriffe) wharves (Figure 4). Smaller vessels may call at the waterfront in the heart of Brisbane (Figure 5). Only river launches operate between Brisbane and Ipswich, many residents along the river having private boat sheds and landings.

FIGURE 6.—A portion of the Bremer River, a tributary entering the Brisbane River at Ipswich, is shown filled with water hyacinth. The ferry crossing is kept free of the weed with great difficulty. Cattle feed in the river margins, especially when drought makes forage unavailable elsewhere.

In the upper Brisbane River and its tributaries navigation by pleasure boats and ferries is commonly handicapped by dense growths of water hyacinth (Figure 6). Its accumulation against bridge piers during floods frequently endangers such structures. Along with prickly pear, lantana, and cape weed, water hyacinth ranks as one of the important plant pests of Australia. During times of drought, however, water hyacinth is dragged from streams by dairymen as emergency feed for cattle. When the streams are in flood the hyacinth is swept into the tidal portions of the river and into the bay where it is killed by contact with salt water.

Floods constitute another important river problem at Brisbane. Channel improvements along the lower river tend to diminish flood hazards somewhat but large tracts of industrial and residential land near the river are subject to occasional inundation. Fortunately the lowlands most subject to overflow are usually devoted only to farming, pasturage, or recreational uses. Major floods usually occur during January, February, and March, the months of heaviest rainfall. Major floods occur at irregular intervals, such as 1893, 1898, 1908, and 1931. During the floods of 1893 all bridges in the vicinity of Brisbane were swept away. The completion of a large reservoir on the Stanley River, one of the principal tributaries of the Brisbane River and about 40 miles northwest of the city, will further reduce flood hazards and incidentally improve the metropolitan water supply (Figure 1).

COMMERCE AT BRISBANE

Brisbane is the principal shipping center in Queensland. Three-quarters of the state's overseas imports and

exports (value basis) are handled through Brisbane. Interstate trade is of greater value than overseas trade. Exports greatly exceed imports in overseas trade while imports are greater in Queensland's interstate trade. The per capita value of all external trade is higher for Queensland (about £60) than for other states.

Analysis of Brisbane's trade reflects Queensland's great diversity of products made possible by its wide range of climatic conditions. Pastoral products are dominant in overseas exports while farm products are more important in interstate shipments. Much of the trade with other states is based on the tropical character of Queensland's farm production, shipments consisting chiefly of sugar, bananas, pineapples, maize, cotton, peanuts, arrowroot, and similar products. Manufactured products from Sydney and Melbourne and from overseas countries are the principal items in the import trade of Brisbane. Small amounts of wheat are imported from other states as Queensland produces only two per cent of the Australian crop. Petroleum products comprise important items of import from abroad, several major distributors having oil storages along the lower river.

Despite the outstanding position of Brisbane among the ports of Queensland, water-borne commerce in that state is decentralized in considerable degree. Brisbane serves only the southern part of the state in many respects but that is by far the most populous and productive portion. During the 1880's and early 1890's the framework of Queensland's railway system was completed. Four independent systems terminated at Brisbane, Rockhampton, Townsville, and Cairns. Although Brisbane later tapped the northern systems by means of a coastwise trunk line most goods continue to be exported

FIGURE 7.—Principal cane growing districts of Australia, sugar mills, shipping centers for raw sugar, and refining centers located in the capital cities of the several states. Thirty-six sugar mills are distributed along the tropical east coast of Queensland and northern New South Wales. They crush annually 4,500,000 tons of cane grown by 8,000 farmers on 300,000 acres of land. Raw sugar is exported from Cairns, Mackay, Townsville, Bowen, Gladstone, and Brisbane, listed in the order of their importance.

from the nearest port of outlet rather than being first assembled at Brisbane. There are six important overseas ports north of Brisbane which handle exports of beef, mutton, raw sugar, timber, and metals. Wool tends to move to Brisbane because of the localization there of extensive sales organizations, but not all Queensland wool moves through those channels. Perishable fruits from centers as far north as Bowen are regularly assembled at Brisbane for rapid delivery by railway to the southern states. Interstate shipments of most other goods, however, move by water rather than by railway.

RELATION TO SUGAR INDUSTRY

Although the immediate district is not of great significance in sugar cane production, Brisbane bears certain important relationships to that prominent Commonwealth industry. Some sugar cane has been grown in the Brisbane district since before 1870; a large re-

FIGURE 8.—The sugar mill at Nambour, located to the north of Brisbane is shown with the usual complement of buildings and sheds built of corrugated iron. Truckloads of cane are brought to the mill on the 24-inch gauge railway which reaches out in all directions through the cane-growing districts. Characteristic Australian rail fences are shown in the foreground.

finery, constructed along the lower river in 1893, treats 35,000 tons of sugar annually for local consumption; large quantities of raw sugar are exported over local docks although five other Queensland ports ship larger quantities; and finally Brisbane serves as an important center from which the industry is operated, financed, and regulated.

Sugar is the implement through which many portions of coastal Queensland have been opened to successful white settlement in recent decades (Figure 7). Sugar has been largely responsible for the creation of new farming districts and numerous milling towns such as Cairns, Townsville, Mackay, Port Douglas, Cardwell, Bundaberg, Innisfail, Ingham, Ayr, and Tully (Figure 8). Most of the population of tropical Australia is concerned directly or indirectly with the sugar industry. Probably 25,000 men are regularly dependent on the industry for their main source of livelihood according to the Queensland Cane Growers Association (Figure 9).

With federation in 1901 Queensland gained free access to all Australian markets along with adequate protective duties on imported sugar. One of the conditions stipulated by Queensland before entering the Commonwealth was that the sugar industry be guaranteed in perpetuity a profitable Australian market for its product. Legislation also provided for the prompt repatriation of Kanaka laborers and the conversion of the sugar industry into one employing white labor by means of bounties on sugar so produced.

During the World War and continuing to 1923, the Commonwealth Government commandeered the entire sugar output, fixed prices to growers and consumers, and regulated exports and imports. High prices during and following the World War stimulated production and soon Australia was obliged to seek markets abroad for surplus sugar. In 1923, complete control of financial and marketing aspects of the industry was turned over to Queensland. Price regulation, concessions to manufacturers of jam and to fruit canners, embargoes on foreign black-grown sugar, and rigid government control have characterized the industry. Queensland agrees to make sugar available in the capital cities at stipulated prices and the Commonwealth agrees to exclude foreign sugar from the home market.

Thus within two decades the industry has expanded from a stage where it was barely able to supply Australian requirements until it is able to export 280,000 tons annually or more than two-fifths of the output. Shipments abroad are made almost entirely to Great Britain, where Australian sugar enjoys a preferential of a half pence per pound, and to Canada. Domestic consumers are obliged to make up losses on exports through bounty payments of a half pence per pound on sugar consumed at home. Such sacrifice is made in the interest of maintaining a "white Australia."

Not only is sugar a vital factor in the

occupation of tropical Queensland but it is a major item in the reciprocal trade between Queensland and the other Australian states. Sugar is exchanged for the manufactured goods and other characteristic products of the cooler states. Sugar is a major item of tonnage in coastwise trade and is regularly sought as ballast for trans-oceanic vessels.

The sugar industry likewise occupies an important position in the economic structure of the Commonwealth. It supplies an indispensable commodity to the entire domestic population and it is a feeder to many home industries. The export of sugar creates purchasing power abroad and contributes to overseas payments. While the Brisbane area is not now a major sugar growing district, it should be emphasized that the industry had its beginnings in that area, and that Brisbane plays an especially important rôle in the administrative phases of the entire Australian industry.

FIGURE 9.—Young cane on valley floor and valley side in the Nambour district. Cane is grown by small independent farmers and processed in the community mill. The farmer's house is shown on the hilltop.

MEAT INDUSTRIES ALONG THE RIVER

Brisbane became a center for slaughtering livestock as soon as private industry was admitted. In 1843, a beef slaughtering and salting plant was established on Kangaroo Point for the processing of cattle for export. Difficulties in marketing the products in England, however, discouraged its continuance. The plant then engaged in boiling down cattle and sheep for tallow during periods of drought.

In 1890, a new phase of the meat industry was initiated at Brisbane when the export of frozen beef was begun. A plant was established at Pinkenba near the entrance to the Brisbane River. In 1895, a second meat freezing works was built at Musgrave Wharf in South Brisbane. Between 1901 and 1912 three freezing works were established along the south side of the lower river at Queensport and a fourth at Redbank, seventeen miles above Brisbane (Figure 2). In recent years two large modern slaughtering and freezing plants and several smaller ones continue to operate along the south bank of the lower river as well as the plant at Redbank. Extensive sales yards at Murarrie and widespread paddocks in the timbered upland fronting on the river are tributary to the slaughtering plants. Numerous small abattoirs are to be found in the Ipswich district. The large state-owned abattoir at Queensport supplies most of the Brisbane area with meat products but it also engages in slaughtering for export (Figure 10).

Brisbane ranks among the largest beef export centers in Australia, and Queensland is easily the principal beef-producing state with about six million head on the interior ranges. Queensland is also an important producer of mutton and lamb, its stations supporting some 20 million sheep. Pork products, too, are handled in the large abattoirs but also in specialized bacon factories. Hog raising is almost entirely localized in the area tributary to Brisbane. It is intimately associated with dairying and with maize production (Queensland's principal cereal crop). In the year 1935-6 Brisbane shipped 60 per cent

of Queensland's foreign exports of chilled beef, 40 per cent of the frozen beef, 40 per cent of the canned meats, and essentially all of the lamb, mutton, pork, and veal.

The localization of meat works along the lower Brisbane River is explained

FIGURE 10.—The large state-owned abattoir at Queensport along the south side of the lower Brisbane River. All slaughtering for the Brisbane area is concentrated at this modern plant which also handles export meats over its own special dock.

principally by the advantage of having direct access to overseas vessels across private wharves. Other advantages enjoyed are the extensive tracts of cheap land on which stock may be held temporarily, availability of the river for disposal of waste water, and escape from the objections which invariably arise when slaughtering plants are in close proximity to residential areas. Fellmongering plants, tanneries, candle works, and soap factories are other establishments closely associated with slaughtering plants in the Brisbane area.

Queensland ranks along with New South Wales and Victoria in the production of butter for export and Brisbane is the principal point of shipment. Extensive modern cold stores are situated at Hamilton for the handling of butter and other perishable products. Smaller cold stores are located along the river in South Brisbane. Butter production now assumes an importance in Queensland as great as that of sugar. Most of the fresh dairy products consumed in Brisbane originate in the vicinity of Ipswich although scattered dairies may be found in most directions from the city.

WOOL SALES AND EXPORT CENTER

Brisbane is the principal wool-marketing and shipping center in Queensland, handling 400,000 to 500,000 bales annually. Some wool is sent directly to the London sales from Townsville, Gladstone, and Rockhampton. The principal wool stores at Brisbane are located along the river at Bulimba Reach (Figure 11), but longer established stores continue to function at Circular Quay in the heart of the city. The concentration of newer wool stores and dumping plants at Teneriffe again reflects the migration of industries dependent on ocean shipping to the lower river in recent decades. River frontage also was available at Bulimba Reach in larger tracts, along with railroad facilities, and also firm ground upon which the expensive structures could be built. At the export wharves wool is dumped through hydraulic presses which reduce its bulk to about half that of domestic bales. Dumping and stevedoring require much common labor. A skin and hide warehouse and export dock occupy a position among the wool stores at Bulimba Reach. The situation of at least one large new wool store several blocks distant from the waterfront reflects the advantage of close proximity to other wool stores for the convenience of buyers even though it lacks direct waterfront privileges.

Sheep are grazed principally in the Mitchell grass area of central Queensland which includes an area about 200 miles wide and 800 miles long from north to south. The chief market centers of the district include Charle-

ville, Blackall, Longreach, Winton, Hughenden, and Cloncurry. Shearing is completed by August or September and the Wool Exchange in Brisbane is active from September to June. Ten sales are held during those months each involving about 50,000 bales. Felmongering and wool-scouring are carried on in the wool-producing districts as well as at Brisbane. Most wool, however, is exported in-the-grease.

CHIEF MANUFACTURING CENTER OF QUEENSLAND

Brisbane ranks easily as the chief manufacturing center of Queensland. In addition to meat and sugar, the principal products of factories in Brisbane are lumber, furniture, pottery, cement, glass, foundry products, automobiles, shoes, clothing, and food products.

Timber is one of Queensland's most important natural resources. Great quantities are being produced along the northern coastal section, as at Cairns, but many sawmills continue to operate in the Brisbane area drawing logs by rail from the tributary area and even by ocean freighter from western Canada. By importing softwood logs from Canada rather than sawn lumber, high import duties are avoided. Local timber is principally hardwood. Timber is relatively cheap in Queensland and large quantities are used for most kinds of construction purposes. Joinery works, plywood manufacturing plants, and furniture shops are widely scattered through the city area.

Many small potteries and brick and tile plants occur in the Ipswich district where easy access to cheap coal is combined with suitable clays from the coal measures. A large lime and cement plant is located at Darra about midway between Brisbane and Ipswich (Figure 2). Local quarries supply most of the raw materials but quantities of coral detritus are brought by river barge and short truck haul from Mud Island in Moreton Bay. Nearby coal mines supply the fuel as would be expected. Extensive concrete pipe and glass works are situated in South Brisbane.

Queensland depends upon New South Wales for its iron and steel products, there being no blast furnaces or rolling mills in the state. A proposal some years ago to establish a state iron and steel works at Bowen, where coal is being mined by the state, failed to materialize. However, foundries, engine works, and small metal-fabricating plants are situated in several portions of the Brisbane area. The Ford Motor Company has an assembly and manufacturing plant along the lower river at Eagle Farm to serve Queensland's needs as is the case in several other states. An iron pipe works in South Brisbane supplies most of the city's needs. The principal railway workshops in Queensland are situated at Ipswich in large part to have access to cheap fuel supplies.

FIGURE 11.—Extensive wool stores (warehouses) and docks along the Bulimba Reach of the river in Teneriffe. Most of Queensland's wool passes through those establishments on its way to overseas markets.

Clothing factories and boot and shoe shops are widely distributed in the city area. In South Brisbane a large boot and shoe factory draws its leather

supplies from its affiliated tannery just across the street. Woolen and cotton mills are among the prominent industries in Ipswich where daughters and wives of coal miners and railway workers find employment. Queensland cotton is grown principally in the vicinity of Mount Morgan (tributary to Rockhampton). Production in the state amounted to over 20 million pounds (unginned) in 1935.

Food manufacturing plants of the usual diversity occur in Brisbane. A large grain storage plant and flour mills lie along the principal wharf in South Brisbane. A factory manufacturing jams, preserves, sauces, and canned fruits is situated in a rural orchard setting at Manly, one of Brisbane's eastern suburbs. Butter factories at Ipswich draw cream from the rich dairylands that lie tributary to that center along the upper Brisbane River. Several breweries occur in portions of the city area generally devoted to industry. Small baking establishments are scattered everywhere—in industrial, business, and even residential districts.

Although Brisbane does not possess large, compact, industrial districts comparable to some in Sydney and Melbourne, manufacturing establishments tend to be grouped in a few localities and commonly they form certain logical associations. As has been shown, the lower Brisbane River district is primarily noted for its slaughtering and allied industries. The Ford plant, a large timber mill, an explosives plant, an electric power generating plant, a large export cold store, and the sewage disposal plant at the river mouth lend industrial variety to the mangrove-bordered lower river-front district. The widely scattered distribution of those large plants along the river without important associated residential development is the most striking urban landscape characteristic of the district.

South Brisbane has always catered to industry in part because a considerable area is less suitable for residential development due to periodic inundation. Easy access to local markets and labor supplies, along with river frontage and adequate railway connections have been other factors attractive to industries not requiring extensive tracts of land. Among the industries carried on there are timber milling and wood working, ship repairs, chemical production, leather manufacturing, printing, implement and engineering works, food and drink manufacture, and numerous other types. Decadent residential areas are being steadily invaded by expanding industry.

The industries of the Bulimba Reach district occur in a narrow belt of lowland bordering the river for a distance of nearly two miles. Principal among them are important timber mills, the sugar refinery, several boat works, the extensive wool and hide warehouses, bulk oil storages, and the large metropolitan electric power and gas works. Nearly all have access to the river and to the state railway system.

Ipswich may be considered to be a fourth industrial district somewhat detached from the Brisbane agglomeration. Coal mines, quarries, railway shops, textile mills, timber mills, butter factories, and small abbattoirs provide a scattered and diversified group of industries. Probably 2,000 men are employed in the mines and an equal number by the railway industries alone.

COAL THE PRINCIPAL SOURCE OF POWER

Twenty-five miles upstream from Brisbane is the principal producing coal field of Queensland. A half million tons or more are produced annually which constitutes about half the state's

output. Production takes place within an area of only about 50 square miles.

The field was opened as early as 1843 when a shipping company opened a pit along the Brisbane River to supply fuel for steamers operating between Sydney and Brisbane. Favorable location with respect to the large Brisbane market, rather than high quality of the coal, accounts for the importance of the field. Mines are small as is indicated by the fact that nearly 50 mines are involved in the annual output. The coal is used mainly for railway operation, electric power generation, and gas manufacture. Small amounts are exported as bunker fuel. Many small satellite towns, as Rosewood, Walloon, Redbank, Dinmore, Blackstone, Abermain, Bundamba, and others, have arisen about Ipswich at colliery locations. Reserves of probably a hundred million tons are available for future extraction at depths of 200 to 350 feet.

Coal is almost the exclusive source of power in the Brisbane area. Two modern carbo-electric power plants are situated along the lower river at New Farm and Queensport. They obtain Ipswich coal by railway, utilizing the river only as a source of water for cooling purposes. Power is served to municipalities within a 25-mile radius of Brisbane including Ipswich. The possibly greater advantage of power plant location along the Brisbane River within the Ipswich coal-producing district (25 miles from Brisbane) affords an interesting local problem for economic study. Gas for industrial and domestic uses in Brisbane is produced in two plants situated along the river at Newstead and at South Brisbane. Coal from Newcastle, N.S.W., is blended with Ipswich coal for gas manufacture. Important coal docks are situated along the river in South Brisbane at which point fuel is transferred from railway hoppers to vessels principally for bunker purposes.

FIGURE 12.—A view to the southwest along Queen Street, the principal axis of the retail district. The intersection in the foreground is important to the shipping and wholesale trade of the city because of easy access to Circular Quay, the wool exchange, customs house, and related institutions.

URBAN WATER SUPPLY

A small creek and a chain of water holes on the site of the Roma Street railway yards provided Brisbane with domestic water until as late as 1866. The murky water was delivered to householders in hogsheads. Most residents depended largely on rainwater caught from the house roofs and stored in barrels and tubs.

In 1863 the municipality was empowered to construct water works to meet the growing needs of the community. The Enoggera Reservoir was completed by 1866 in a narrow valley in the upland eight miles west of the city (Figure 2). In 1885 another supply was completed on Gold Creek, fed by a small watershed adjacent to that of Enoggera Creek. By 1890 additional water was needed and the Brisbane River itself was tapped near Mt. Crosby above the influence of tidal action. The water was lifted to a sufficient height to allow it to gravitate through an 18-mile pipe line into the service reservoirs within the city. It remains the principal source of water for Brisbane,

Ipswich, and most of their satellite communities. A concrete weir 20 feet high and 550 feet long impounds a half billion gallons of water. The drainage area of the Brisbane River is roughly 100 miles in length from north to south and 50 miles wide, all of which lies on the seaward flank of the Great Dividing Range (Figure 1).

In order to provide against long periods of low flow in the Brisbane River a storage reservoir with a capacity of more than five billion gallons has been provided in Lake Manchester. That storage is situated in a valley tributary to the Brisbane River a few miles above the Mt. Crosby pumping plant. Water is pumped from the Brisbane River in times of abundant flow into Lake Manchester for storage. Additional storage is being provided in the large Stanley Reservoir located on another tributary stream forty miles northwest of Brisbane. Because of the large amount of sediment carried in the Brisbane River all water for municipal purposes is filtered.

The small average daily per capita consumption of forty gallons may be explained in part by the fact that many

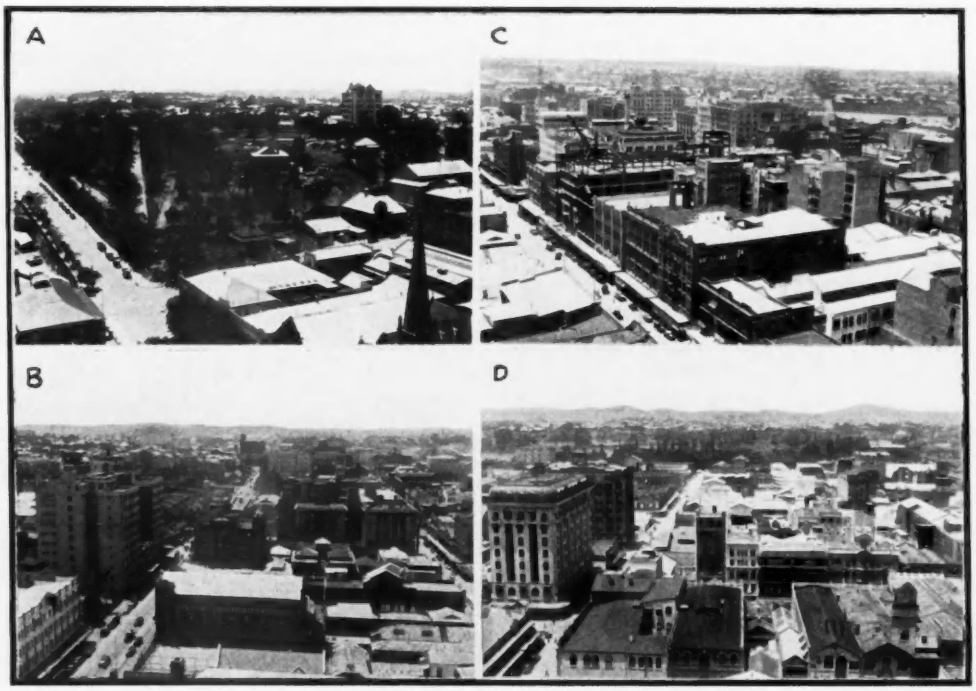

FIGURE 13.—These views, as well as those shown in Figure 14, were taken from the tower of the City Hall in the commercial district. They provide a panoramic view of the central city and bordering manufactural and residential districts. See Figure 3 for location of City Hall.

A. View to the north across Wickham Park and the Spring Hill district. A circular stone windmill tower of the convict period, now used as an observatory, may be seen near the top of the hill.

B. Northeast view along Ann Street (left) and Adelaide Street (right). The round low roof of the Central Railway Station may be seen beyond the large modern Canberra Hotel along Ann Street.

C. East view across Adelaide Street (left) and the heart of the commercial district which parallels Queen Street. The Circular Quay portion of the river is shown at the right and the eastern suburbs appear in the distance.

D. Southeast view along Albert Street (left) and showing the important Queen Street crossing (T. & G. Life Society Building). The extensive Botanic Gardens with the Parliament House and Queensland University are shown at the end of Albert Street. Note the range of hills which tends to define the Brisbane area to the southeast.

residents continue to utilize run-off from house roofs. Large galvanized iron tanks are attached to the majority of homes for the storage of soft rainwater. A second factor in the low per capita use of city water is the backwardness of the city in providing sanitary plumbing. Less than one-third of the population of Brisbane and tributary suburbs is served by modern sanitary sewers. Those services are being extended as rapidly, however, as conditions warrant. The outfall sewer extends along the north side of the river and empties through a modern treatment works at its mouth.

CENTRAL COMMERCIAL CORE

The axis of the commercial core of Brisbane is Queen Street and its extensions to the southwest across the river and to the northeast into adjoining suburbs (Figure 12). There are situated the principal retail stores, banks, office buildings, theaters, and the central post office which in every Australian city is a center of great municipal importance. Sharing in such development

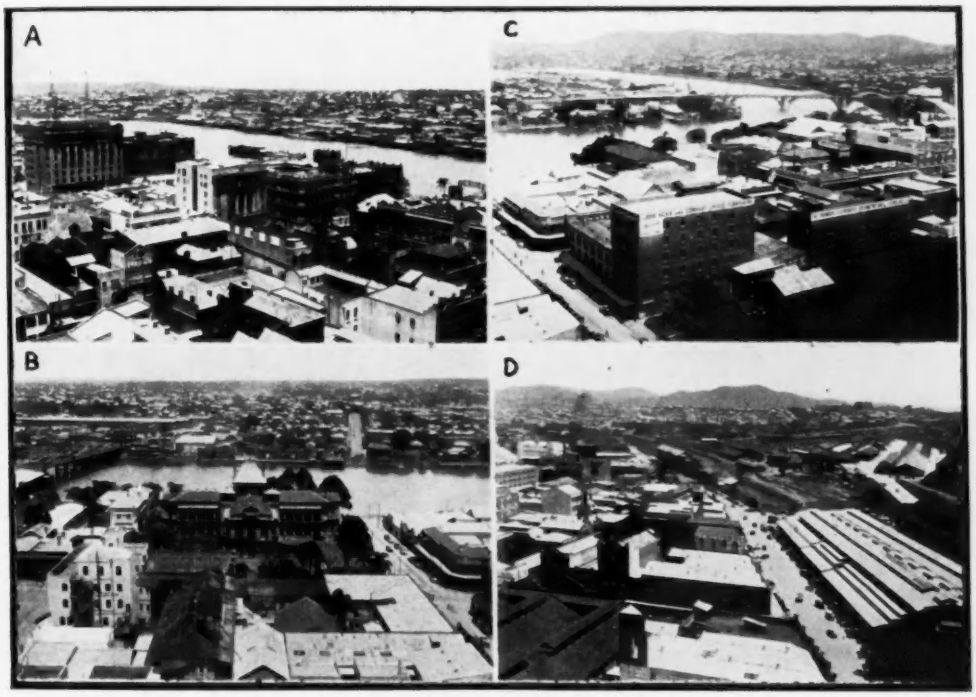

FIGURE 14.—Views taken from the tower of City Hall. (See Figure 13.)

A. South view showing the extensive development of government buildings near the southwest end of Queen Street and along William Street. The South Brisbane (Musgrave) wharves are shown across the river in the vicinity of which many manufacturing plants have arisen.

B. Southwest view showing the important Victoria Bridge crossing to South Brisbane. Beyond is the long low roof of the railway terminal of the standard gauge line providing direct connections with the New South Wales system. The Brisbane River above (right of) the fixed Victoria Bridge is navigable only for small river craft. The large building near the center houses the Public Courts.

C. West view over warehouse and wholesale district and showing the Grey Street Bridge. Several large industrial plants are shown along the river margin in South Brisbane. The Mt. Coot-tha upland which attains an elevation of 933 feet and which limits city expansion to the west is shown on the skyline.

D. Northwest view over the metropolitan produce terminal (lower right) and the Roma Street railway yards and freight terminals. Attractive new residential communities have risen on the lower slopes of the foothill range at the west city margins.

are the adjacent parallel streets (Adelaide and Elizabeth to the northwest and southeast respectively), and the principal cross streets (Edward, Albert, George, and William in order from northeast to southwest). Government offices are distributed along William Street in close proximity to many hotels. While Queen Street is 80 feet wide, others in the core area are only 66 feet wide which results in seriously congested traffic conditions even though automobiles are considerably less numerous than in American cities of equal size. There are on the average ten persons per motor vehicle in Queensland. Suburban retail centers are scattered along the tram lines but are subsidiary in importance to the core retail district. Wholesale and warehouse districts lie to the southeast of the retail area along Charlotte, Mary, and Margaret streets adjacent to the Circular Quay wharves and to the west near the Roma Street railway yards and terminals. Impressive buildings occupied by large banking institutions, insurance companies, warehousing firms, and various federal and state government departments lend a metropolitan aspect to the core area.

A series of photographs taken from the tower of the City Hall (location on Figure 3) and in the direction of the eight principal points of the compass provides detailed views of the central city and panoramas of the bordering industrial and residential districts. (Figures 13 and 14.)

BUNGALOW RESIDENCES CHARACTERISTIC

In Queensland and adjacent portions of New South Wales the usual house type reflects the tropical or semi-tropical environment. Single-story wood bungalows with low-pitched sheet iron roofs, wide verandas, and sleeping-out loggias, all carefully screened to keep out flies and mosquitoes, are characteristic. Mosquito nets are commonly suspended over beds to insure comfort. Most houses are perched upon wooden posts, six or more feet off the ground, to provide adequate ventilation and coolness in summer, protection from surface run-off, and safety from wood-eating termites (Figure 15). Metal shields (like inverted pie pans) are placed on the tops of the posts to insulate the houses against termites. When trellised-in, the space beneath houses provides room for cars, laundries, tool storage, ferneries, and play space for the children. Such building arrangements provide a sharp contrast to the low squat appearance of the average small residence in the cooler portions of Australia. The recent construction of a few stucco houses of Spanish, Italian, and California types built on low concrete foundations may initiate a new trend in house design in Brisbane. Many of Brisbane's oldest houses (some built of stone) were constructed on normal foundations.

Wood is the most common home construction material in Brisbane. Eighty-three per cent of Queensland's private homes are made of wood according to the 1933 Census. Wood is abundant and cheap. The widespread use of sheet iron (usually painted light gray or red) as a roofing material lends architectural character and color to the urban scene. Brightly colored tiles are used for roofing material on some of the newer homes. Split paling fences are common about Brisbane residences affording much privacy but detracting from the beauty of residential streets. The custom of licensing livestock to graze the country roads and even suburban streets makes it essential that crop lands and dooryards be securely fenced.

Brick and stone residences are exceptional in Brisbane although many business establishments are built of those materials. Enoggera granite, with a pinkish tinge and fine grain, is widely used in public buildings and for curbing. Quarries occur in the hills a few miles west of the city. Toowoomba basalt from the plateau to the west of Brisbane is also commonly used for curbs and gutters but not for buildings. Local sandstones and diorite are widely used for building, curbing, and road-making purposes. Occasional buildings in Brisbane are constructed of sandstones from Sydney and Melbourne.

The detached single-family residence is most characteristic in Brisbane. The proportion of flat dwellers in Brisbane (four per cent) is less than half the proportion in Sydney. The proportion of homes occupied by owners is higher in Brisbane (63 per cent) than in any other of the capital cities.

The generally hilly character of the Brisbane site greatly increases the possibilities for effective landscaping in public parks as well as about private residences. Residential lots in many parts of Brisbane have frontages of 60 feet or more which makes for more attractive spacing of residences and gives ample room for ornamental plantings. An especial interest in maintaining ornamental gardens about private homes may be attributed to the year-round attraction of that outdoor hobby. From the higher slopes extensive views of the Brisbane River winding seaward may be had along with views of island-studded Moreton Bay. To the west, heavily wooded hills provide another attractive outlook.

Brisbane is justly famous for its flowering trees and vines which lend brilliant color to its parks and dooryards throughout the year. The vivid scarlet of hibiscus, rose-colored bougainvillea,

FIGURE 15.—Characteristic modern residence of Brisbane. The entire structure is built on stumps six or eight feet above the ground level in order to secure ample ventilation and freedom from dampness. A sheet-iron roof covers the wooden structure. Note the "pie pans" on top the stumps which effectively insulate the house from termite attack.

flaming red coral trees, delicate lavender of jacaranda, purple of Bauhinia, and brilliant blossoms of Poincianna when combined with clumps of bamboo and feathery palms provide a colorful tropical setting to be matched in no other Australian city. Stag horn and elk horn ferns are extensively used for outside wall decorations on Brisbane homes.

Papaya, mangoe, and other tropical fruit trees fill the dooryards throughout the city. One of the features adding color and distinction to the retail districts of Brisbane is the large number of fruit stores with their extensive offering of colorful tropical and middle latitude types. Many small fruit farms are scattered through a wide belt of semi-rural land bordering the city. Vegetable farming is largely in the hands of Chinese while Italians are commonly engaged in dairy farming and local fruit growing.

Public recreation grounds and parks are commonly associated with river frontages and also with nearby rugged upland areas. Bowling, horse racing, golf, tennis, cricket, croquet, sailing, and swimming attract great numbers of participants. Queenslanders, like

other Australians, spend much of their leisure time in outdoor sports.

Sandgate and Wynnum are Brisbane's most accessible seaside residential and recreation centers. Both communities are situated on lands which rise somewhat above the generally low marshy shores of Moreton Bay. Miles of sandy beach lying in the lee of Moreton and Stradebroke islands provide excellent bathing opportunities. Long piers extend over a wide rocky platform to deep water. The outlet of Wynnum Creek provides a shelter for small pleasure boats.

Bribie Island, at the north end of Moreton Bay, is a popular resort with good beaches and fishing. Beyond the limits of Moreton Bay, both to the north and south, numerous resort centers offer full exposures to the Pacific to thousands of persons from Brisbane on holidays or during longer vacation periods.

The dress of men and women in Brisbane reflects the tropical climate and is more colorful than in the southerly cities. White suits and cork helmets, shirt sleeves, and khaki shorts are characteristic wear. Less haste in the day's work is apparent in Brisbane than in Sydney or Melbourne.

CONCLUSION

Marked concentration of population in the capital city (nearly one-third of the state's million inhabitants live in Brisbane), outstanding position in commerce and manufacturing within the state, center of a vigorous and influential state government, focal point in the state transport pattern, chief cultural and social center for a large area—these are some of the significant characteristics of Brisbane. The same qualities apply equally to every other capital city in Australia. Other factors, however, such as unique elements of local situation, positon at the northern and tropical extremity of the chain of large coastal cities, differences in resources and productive capacities of its hinterland, and many distinctive features of its complex socio-economic development give dissimilar character to Brisbane. All of those qualities may be detected in the various elements of areal expression in the urban landscape. Thus, in its composite reality, Brisbane stands unique among Australian cities.

GEOGRAPHY OF THE UNITED STATES COTTONSEED OIL INDUSTRY

George F. Deasy

ANNUAL production of vegetable oils from domestic oil-yielding seeds in the United States exceeds one million tons. This quantity represents approximately sixty per cent of all vegetable oils annually consumed in this country.

Despite the predominant position of domestic vegetable oils in the fats and oils economy of the United States, little has been written in geographical literature concerning them. Greater attention has been given to imported oils and geographical aspects of their production. The purpose of this article, therefore, is to direct attention to the outstanding American vegetable oil—cottonseed oil, and to summarize briefly some of the points of geographic significance in its production.

Importance of Cottonseed Oil

The cottonseed is the world's most important source of vegetable oil. The United States, in turn, is the outstanding producer of cottonseed, contributing over one-third of the world's production (Figure 1). American output of cottonseed oil is so large that it represents between two-thirds and three-fourths of the total vegetable oil output of this country, in spite of the significant quantities of other such oils produced here (Figure 2). Yearly production in the United States is exceeded in volume by only one other fat, butter, since domestic output of lard during recent drought years has fallen below that of cottonseed oil.

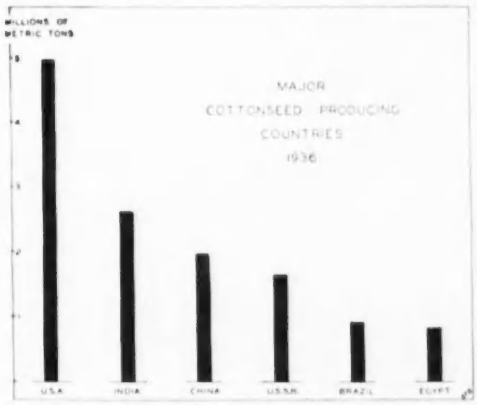

FIGURE 1.—Until recently the United States accounted for well over fifty per cent of the world's supply of cottonseed. Today this figure has fallen to about thirty-five per cent. (Source: International Institute of Agriculture, Rome, 1939.)

Factors in Development

The American cottonseed oil industry, like the cotton fiber industry, gained its initial impetus with the invention of the cotton gin. Before that time the quantity of seed available was too small to support a commercial industry, and the value of the seed and its oil remained almost unknown. Even after the invention of suitable machinery economically to separate cotton fiber from the seeds, the latter remained useless waste for some time. Increasing amounts of seed not needed for planting were considered a nuisance and were generally destroyed. However, efforts were made to discover uses for the growing cottonseed crop. Experimental oil mills sprang up during the first third of last century, and in 1834 the first important commercial mill was built at Natchez, Mississippi.

Growth of the industry was slow. Animal fats and oils were plentiful and cheap in this new and sparsely

populated country, oil refining methods were crude, and popular prejudice against vegetable oils prevented their widespread acceptance. As late as Civil War days there were only seven active cottonseed mills in the country, and until 1880 only some five to ten per cent of the total cottonseed harvest was crushed. The oil output then was but a small fraction of present production.

During the last two decades of the nineteenth century, however, the United States cottonseed oil industry sprang into life as new refining and treating processes were perfected and as growing population resulted in rising prices for animal fats and oils. Within the last sixty years the output of cottonseed oil in America has doubled and redoubled many times. Today, over 450 active mills crush an annual cottonseed crop ranging between three million and six million tons, and produce between one billion and two billion pounds of crude cottonseed oil annually (Table I).

TABLE I

UNITED STATES COTTONSEED AND COTTONSEED OIL STATISTICS

1875–1938 (five-year intervals)

Crop Year	*Seed Crushed (tons)*	*Percentage Total Seed Produced*	*Number of Operating Mills*	*Crude Oil Produced (pounds)*
1875	123,000	6.0	...	37,050,000
1880	182,000	6.0	45	54,675,000
1885	578,000	19.0	...	173,550,000
1890	1,023,000	25.0	119	306,975,000
1895	1,435,000	42.0	...	430,425,000
1900	2,415,000	50.0	...	724,575,000
1905	3,131,000	61.9	...	942,750,000
1910	4,106,000	79.3	...	1,259,775,000
1915	4,202,000	84.2	...	1,253,325,000
1920	4,069,000	68.1	...	1,309,183,000
1925	5,558,000	77.7	...	1,617,015,000
1930	4,715,000	76.2	510	1,441,882,000
1935	3,818,000	80.7	471	1,163,736,000
1936	4,498,000	81.6	461	1,363,978,000
1937	6,526,000	75.1	466	1,961,486,000
1938	.....	.....	...	1,409,000,000

Source: United States Department of Commerce

FIGURE 2.—Cottonseed is the outstanding domestic source of vegetable oil in the United States, accounting for over seventy per cent of the total production in 1938. Tung oil data for 1937. (Source: United States Department of Agriculture, 1939.)

MAJOR CENTERS OF COTTONSEED PRODUCTION

The cottonseed producing area of the United States corresponds almost exactly with the cotton fiber producing area of the country. That is to say, there are essentially no localities in the American Cotton Belt in which the seed remains unmarketed, except that required for planting and a small percentage saved by some farmers for livestock feed. Every cotton farmer is a seller of seed.

Since cottonseed production is a function of cotton fiber production, the boundaries of the cottonseed producing region are identical with those of the well known Cotton Belt—namely, 200 frost-free days in the north, 20 inches of rainfall on the west, and relatively wet autumns, infertile soils, or poor drainage conditions to the south and east. Likewise, since seed output is closely related to lint output, the major seed producing centers within the Cotton Belt are identical with the major lint producing regions: (1) the Piedmont and Inner Coastal Plain of the southeastern states; (2) the alluvial lands of the Mississippi River flood plains, and (3) the Coastal Plain and Prairies of eastern Texas and southern Oklahoma (Figure 3).

Outside the Cotton Belt, minor cottonseed producing areas are found in irrigated districts of the Southwest, in California, Arizona, and New Mexico.

SIGNIFICANCE OF COTTONSEED TO THE SOUTHERN FARMER

The large part played by cottonseed in the economic life of the cotton farmer of the South is seldom realized by people outside that section of the United States. The former waste seed of the cotton plant now forms the second most important cash crop of that part of the country, being exceeded in value only by cotton lint. In fact, since the bulk of the lint is mortgaged by the small farmers before maturing, the only actual cash that passes into their hands at the end of the year is that derived from the sale of the seed. This is due to the general practice of exempting cottonseed from crop mortgages. As a consequence, cottonseed is relatively more important to many cotton farmers than is lint cotton, and the average southern farmer is frequently more concerned over the price of cottonseed than he is over the price of lint.

MOVEMENT OF SEED FROM FARMS TO CRUSHING MILLS

Two objectives must be attained between the time that the cottonseed (mixed with lint) leaves the producing farms and the time that it arrives at the crushing mills: (1) separation of the seed from the lint, and (2) concentration of the seed as soon as possible into quantities sufficiently large (carload lots or better) to reduce the unit cost of transportation. (A third objective, not concerned with the seed, is compression of the lint into bales for easy handling and cheap transportation.) The cotton ginneries are the intermediaries that perform these services. There are some 13,000 ginneries in the United States, most of which are found widely distributed throughout the Cotton Belt

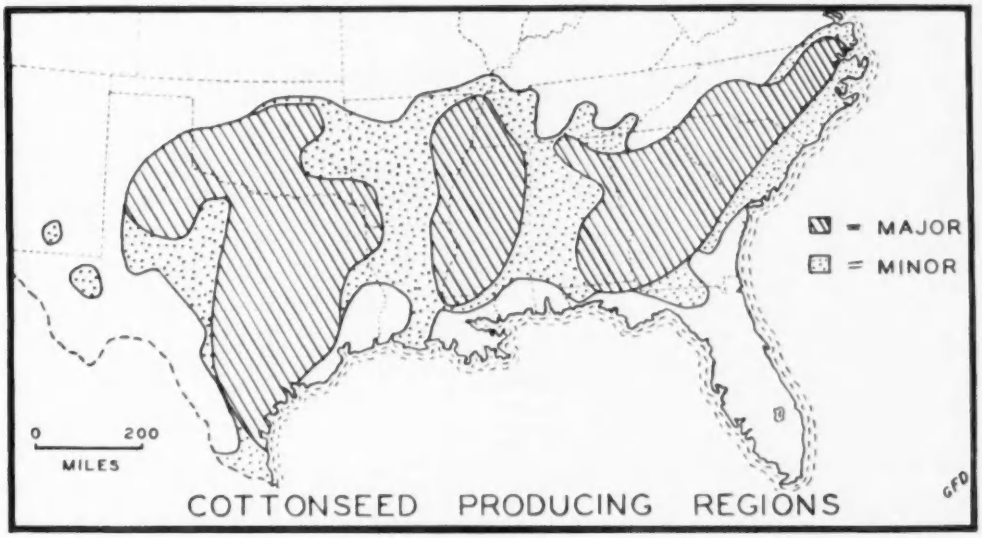

FIGURE 3.—No dot distribution map of cottonseed production in the United States is available. However, the above map gives a general idea of where the major and minor producing areas are located. Minor producing centers in the irrigated sections of the Southwest have been omitted.

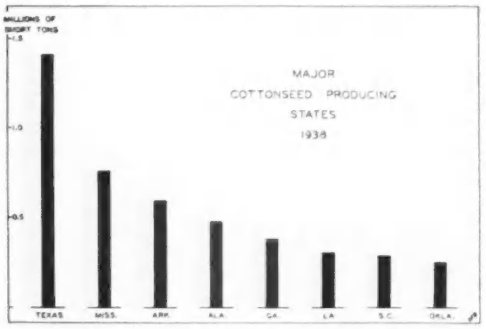

FIGURE 4.—Leading cottonseed producing states in the United States are identical with the important cotton lint producing states, since there are essentially no localities in the Cotton Belt in which the seed remains unmarketed. (Source: United States Department of Agriculture, 1939.)

and as close to the cotton producing centers as possible. There are, roughly speaking, some thirty ginneries to every cottonseed crushing mill.

The harvested fruit of the cotton plant (seed cotton) is generally hauled by wagon or automobile truck a short distance (a few miles or so) to the nearest cotton gin by the individual farmer. When the process of separation has been completed, the few bales of lint are generally returned to the grower for disposition by him (usually for payment of a mortgage), while the bulk of the seed is bought immediately by the ginner. Seed from many such small-lot purchases is eventually accumulated by the ginner until one or more carlots are obtained. These are finally shipped in bulk by rail to the more distant and numerically fewer crushing mills (Figure 5).

LOCATION OF AMERICAN COTTONSEED OIL MILLS

During the period when the American cottonseed milling industry was first developing, mills were generally located where the seed and products could be collected and shipped by water. The difficulty of assembling seed by wagon over roads that were little more than trails was a major factor in retarding establishment of interior mills. As a result, early mills were usually erected in the larger river and ocean port cities such as New Orleans, Memphis, Natchez, Savannah, and Charleston. Also, the general lack of developed industrial facilities throughout most of the cotton producing areas of the Old South caused several cottonseed crushing mills to gravitate to northern river and ocean port cities such as St. Louis, New York City, and Providence, R. I. (Figure 6).

Today, the far more numerous American cottonseed mills are found well distributed throughout the South (Figure 7). Not only are adequate transportation and industrial facilities now available in that part of the country, but mills located there also enjoy the exclusive advantages of proximity to raw materials and a low-wage labor supply. Major centers of concentration of such mills correspond to the three major seed producing districts of the South (Figure 7). In all, there are some 450 mills, with an average annual seed crush of 8,000 to 13,000 tons each.

A few mills are located in the irrigated cottonseed producing sections of the

FIGURE 5.—Negroes unloading uncrushed cottonseed from freight cars into conveyors. Such low wage labor is one of the reasons for concentration of crushing mills in the South.

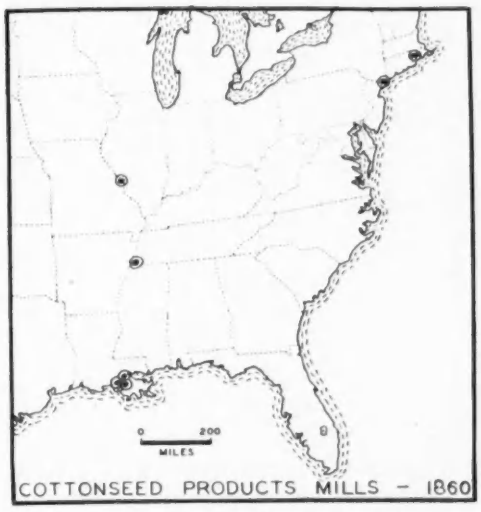

FIGURE 6.—In 1860 there were only seven cottonseed processing mills in the entire United States, three at New Orleans, and one each at Memphis, St. Louis, New York City, and Providence, Rhode Island. Note their peculiar distribution as compared with that of present-day mills, shown in Figure 7. (Source: National Cottonseed Products Association.)

Southwest, but none is now situated in the North.

SOME PROBLEMS CONFRONTING THE MILLING INDUSTRY

The cottonseed milling industry, like any other processor of agricultural raw materials, is faced with certain problems that have their bases in the agricultural character of the commodity being treated.

One of the unique problems of the cottonseed miller is the discrepancy that exists between supply and demand for cottonseed. Overproduction is never a consideration, since there is always a ready market for the seed and its products. Hence the mills each year buy all available production.

But production of cottonseed fluctuates greatly from year to year (Figure 9). It is not determined by demands of the mills for raw materials, nor by consumer demands for seed products. Instead, it depends entirely on size of the cotton fiber crop. Hence, while the crushing capacity of the industry

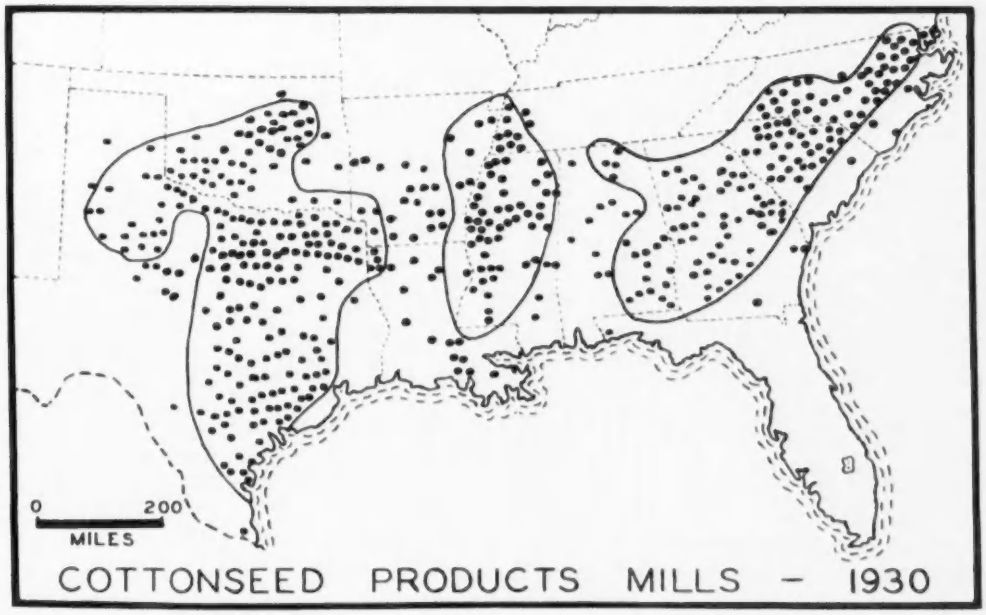

FIGURE 7.—Each dot represents one cottonseed crushing mill in the United States. The capacity and output of the individual mills vary considerably, however. A few mills located in the southwestern states are not shown. The lines encircle the areas of major cottonseed production. (Courtesy of The Buckeye Cotton Oil Company, Cincinnati.)

must be sufficiently great to handle the seed from the largest cotton crop, the usual situation is for the mills to operate at subnormal capacity. As a result, excess equipment lies idle, production costs rise, and many units in the industry may find operation unprofitable.

Another problem of the cottonseed milling industry, and one common to most other agricultural processing industries, is the necessity for concentrating the bulk of milling activities within a fractional part of the year. Neither individual farmers nor ginners are generally equipped to store and care for the seed, and they therefore must market it immediately after it is ginned.

Cottonseed begins arriving at the mills about the first of August, the beginning of the cotton-harvesting season. By September the seed is reaching the mills in enormous quantities. Within the three-month period, September to November inclusive, some two-thirds of a season's seed crop has been shipped. As the cost of warehousing and caring for the seed is considerable, the crushing mills tend to market their output immediately, regardless of current demand. Normally, over three-fourths of the entire crop is crushed and sold during the half-year, September to February inclusive (Figure 10). The result, of course, is a seasonally glutted market and abnormally low returns for both the mills and the individual farmers. In addition, inactivity of the greater part of the crushing equipment for the remainder of the year raises unit cost of production.

FIGURE 8.—Air view of a large cottonseed mill at Memphis, Tennessee. (Courtesy of The Buckeye Cotton Oil Company, Cincinnati.)

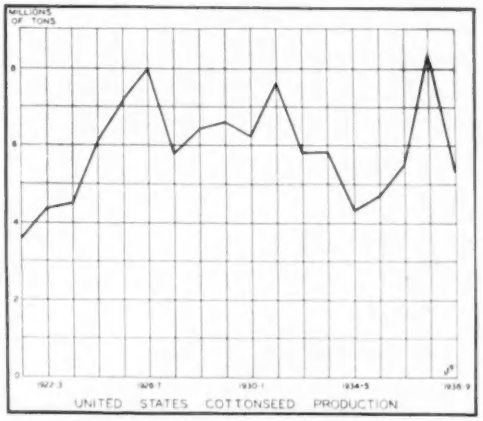

FIGURE 9.—Note the marked fluctuations in annual production of cottonseed in this country. Cottonseed mills must be equipped to handle the largest crop. Data obtained from lint production—sixty-five pounds of seed for each thirty-five pounds of lint. (Source: United States Department of Agriculture.)

A third and final problem of the cottonseed milling industry, as well as of the cottonseed growers, is that of competition from other vegetable and animal fats and oils. These products are peculiarly adaptable to substitution, one for another. It is true, some oils are naturally superior to others for certain purposes (tung oil for paints and varnishes, for instance). But these superiorities and inferiorities can frequently be overcome by refining or other chemical treatment, at a slight increase in price. Hence, a vegetable oil like cottonseed oil must have its price maintained sufficiently low and must be available in large enough quantities to meet active competition from a vast host of related oils and fats. The cottonseed oil industry, therefore,

finds it necessary to wage a constant battle (technological, legislative, advertising, etc.) against the lard producer, the butter manufacturer, the coconut oil producer, the soybean oil and other manufacturers. Such competition is somewhat more extreme than that found in many other industries, because of the ready interchangeability of competing products.

USES OF COTTONSEED OIL

The outstanding use of cottonseed oil in the United States is for food products, particularly vegetable oil shortening (Figure 11). In 1938, over sixty-eight per cent of the total factory consumption was used in shortening, in which it was the outstanding vegetable oil constituent. A major advantage of cottonseed oil over many other vegetable oils is that it does not readily decompose and smoke or sputter when heated, which adapts it for use as a cooking oil and fat.

Cottonseed oil has no close competitor in the shortening field in America, or in the miscellaneous edible products field (salad oils, salad dressings, etc.), but a strong competitor, and until 1936 the leader, in the oleomargarine industry was coconut oil. Like most other vegetable oils, minor quantities of cottonseed oil enter into all other consuming channels.

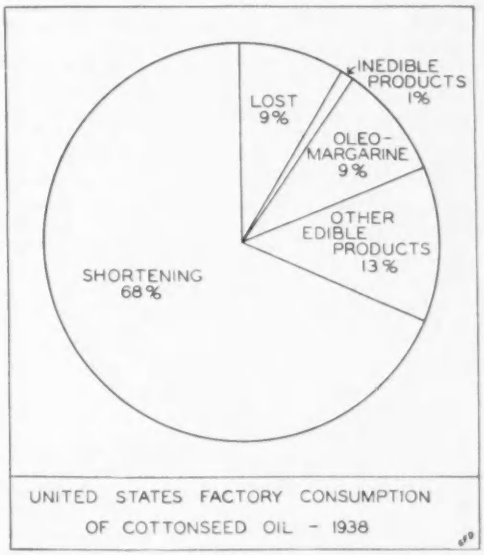

FIGURE 11.—Use of cottonseed oil in the United States is chiefly for food, or in the preparation of food. It constitutes one of the most productive sources of fats, so essential to life and modern industry. It does not decompose readily, and because it makes little smoke or sputter when used in cooking, it is popular in the home kitchen.

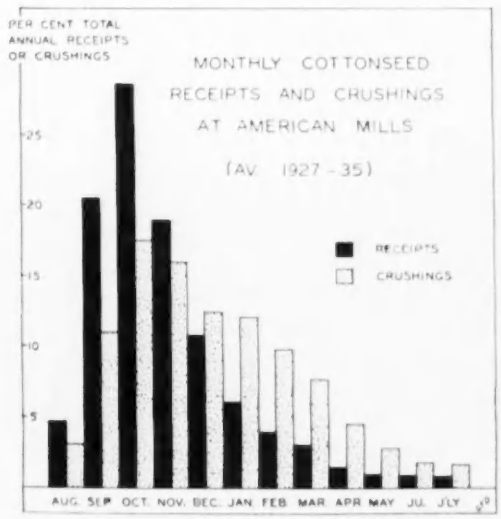

FIGURE 10.—Note the great concentration of cottonseed shipping and milling activities from September to March, and the relative stagnation of the industry during the remainder of the year. (Source: United States Bureau of the Census.)

FUTURE OF THE UNITED STATES COTTONSEED OIL INDUSTRY

The future of cottonseed oil production in the United States is intimately related to the cotton fiber industry of this country. Since the cotton plant is cultivated primarily for its yield of lint and the seed is merely a by-product (value of cottonseed represents from one-fourth to one-eighth of the value of ginned cotton), the domestic and world demands for cotton fiber and the relative ability of the American cotton industry to compete for this market will

determine the size of the cotton crop and ultimately the amount of cottonseed oil available. Hence, the outstanding vegetable oil product of the United States is in the peculiar position of responding, not to increases or decreases in demands for vegetable oils, but instead to fluctuations in demands for an entirely unrelated product.

The recent government curb on cotton production in an effort to maintain the price of lint at a profitable level, and the tendency toward diversification of agriculture in the South during recent years, may vitally affect the American cottonseed oil situation. If cotton production is thus limited for any considerable length of time, the supply of such oil will be insufficient to meet increasing domestic demands and competing domestic and foreign oils will benefit.

AGRICULTURAL REGIONS OF AFRICA

PART II. VEGETATION AND POTENTIAL PRODUCTIVITY OF THE LAND (*Concluded*)

H. L. Shantz

Southwest African Mandate

THIS mandate lies between the province of the Cape of Good Hope on the south and Angola on the north and extends inland from the Atlantic to Bechuanaland on the east. The area is about 312,000 square miles, or with the northeastern extension, the Caprivi Ziffel which is now administered by Bechuanaland, about 322,000 square miles (Figure 191). It is mostly a plateau, sloping east and south, varying in elevation from about 2,500 feet in the south to 4,800 in the north. In the west, mountains rise to 8,200 feet.

The streams within the mandate are drainage channels which are dry during drought periods. The west slope is a nearly rainless desert known as the Namib.

In the northeast, dry forest covers most of the area amounting to about 42,000 square miles. This area produces an abundance of wood and small timber, is valuable grazing land of high carrying capacity, and capable of producing warm-weather crops. However, droughts are common and the rainfall very uncertain.

About 54,000 square miles is covered by acacia–tall grass savanna of the drier type. It is grazing land and warm-weather crop land and produces wood and timber of value. Acacia–desert grass savanna occupies about 102,000 square miles of land suitable only to grazing. Similar to this, but more arid, are 81,000 square miles of desert shrub–desert grass which have a very low carrying capacity but otherwise are valuable grazing lands.

A desert of about 28,000 square miles lies along the Atlantic on the west where the rainfall average is as low as one inch per year and where some of the most interesting and highly adjusted desert plants of the world are found. The land has no grazing value.

Along rivers and some of the sinks, sub-irrigated or irrigated land probably amounts to about 2,000 square miles. These are referred to here as oases. Marsh grass of about a thousand square miles and about 2,000 square miles of salt desert shrub or salt pans, which always develop in interior drainage basins in semi-arid country, complete the area.

Land Use.—There are no true forests in the protectorate. Woodlands, mostly in the northeast, amount to about 44,000 square miles, 14 per cent of the total area. Here are small timbers and wood in abundance, such as onusodo, tambooti, camel thorn, and mopane.

Grazing land of high carrying capacity occupies about 99,000 square miles, nearly a third of the area. A much greater area of 185,000 square miles, 59 per cent of the area, is grazing land of low carrying capacity. The total of grazing land suitable to cattle, sheep, and goats is 284,000 square miles, 91 per cent of the area. Much of this has a very low carrying capacity. Here are produced, by Europeans, cattle, goats,

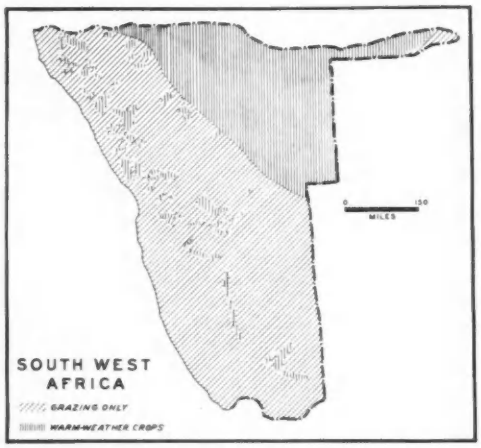

FIGURE 191.—Southwest Africa has an area of nearly 312,000 square miles. About 98,000 square miles are suitable for warm-weather crops and 214,000 square miles for grazing only.

sheep, donkeys, horses, pigs, and mules. Native production is chiefly goats, cattle, sheep, donkeys, horses, and a few pigs and mules. The total production amounts to 1,421,000 animal units, or 5 per square mile of grazing land.

Wild game, including some of the most prized members of the antelope family such as roan and sable antelope and tufted beisa, and many other prized game species are found here. At the present time many species which were becoming scarce are given special protection.

Land Classification.—About 98,000 square miles or nearly a third of the area is warm-weather crop land. Most of this area, however, is subject to drought. Here are produced maize, potatoes, Kaffir corn, wheat, tobacco, and citrus.

The agricultural exports are chiefly skins, fresh and frozen meat, hides, and wool. They amount to about $4.60 per square mile of agricultural land. In this case the products come almost entirely from the grazing lands of the protectorate. A prominent item in the export value is skins of karakul sheep which are exported as astrakhan pelts. A fine of 500 pounds or three months' imprisonment is imposed on anyone smuggling one of these sheep from the protectorate.

The population density is 0.8 per square mile, or if based on agricultural land only, 2.7 per square mile. There are about 9.8 natives to one European.

ANGOLA

Angola lies between the Congo on the north and Southwest Africa on the south and is bounded on the east by the Congo and Northern Rhodesia. The area is about 486,000 square miles (Figure 192). The principal features are the desert on the southwestern coast and the large plateau at 5,000 to 6,000 feet elevation inland from this desert area. The remaining eastern two-thirds has an elevation of from 2,000 to 5,000 feet and drains mostly north and east to the Congo and southeast to Bechuanaland. A small area in the east drains to the Zambezi.

A tropical rain forest is developed in small areas and probably does not exceed 3,000 square miles. The temperate rain forest along the southwestern highlands may cover an area of 5,000 square miles. The dry forests cover an area of about 271,000 square miles. This land is warm-weather crop land and grazing land. It is also valuable for wood and small timber.

The high grass savanna of 110,000 square miles along the Belgian Congo is grazing land of high carrying capacity and is suitable for warm-weather tropical crops. Acacia–tall grass savanna covers 54,000 square miles. High grassy plateaus in the east are classed as mountain grassland and probably do not exceed a thousand square miles in area.

Extreme desert of about 3,000 square miles along the southwest coast, 14,000 square miles of desert shrub–desert

grass, and about 22,000 square miles of acacia–desert grass savanna are areas unsuited to crop production. Marsh grass of probably 2,000 square miles, and oases or subirrigated land of 1,000 square miles complete the area.

Land Use.—Forests as such are almost absent and not over 8,000 square miles could be so classified. Woodlands are extensive, covering about 272,000 square miles, 56 per cent of the area. Here wood and small timber are produced in abundance.

Grazing land of high carrying capacity covers 439,000 square miles, 90 per cent of the total area. Grazing land of low carrying capacity occupies only 36,000 square miles, 7 per cent of the area. The combined area, 475,000 square miles, or 98 per cent of the total, is probably not well adapted to cattle and a rough estimate of land suitable for cattle would be 208,000 square miles, about 43 per cent of the total area.

Here cattle, pigs, goats, sheep, donkeys, horses, and mules are produced. The total production amounts to 1,216,000 animal units, or 2.6 per square mile.

Big game animals of many interesting species are found in Angola since here are the forms characteristic of the southwest semi-desert area and of the savanna and dry forest type of central Africa.

Land Classification.—Probably much of the highlands can be used for either short season warm-weather or cool-weather crops. Only 6,000 square miles are here considered cool-weather crop lands. Wheat, maize, and tobacco are produced.

Warm-weather crop land covers an area of 439,000 square miles, 90 per cent of the area. Here are produced by Europeans, sugar cane, cacao, sisal, coffee (*C. robusta*), and palm oil, and by natives, maize, coffee, cotton, tobacco, sesame, sugar cane, rice, and groundnuts. Natives also collect palm oil and rubber.

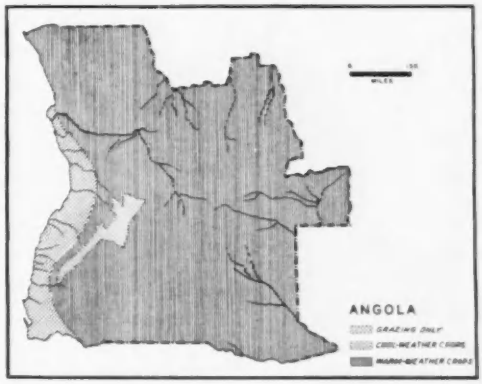

FIGURE 192.—Angola has an area of a little over 486,000 square miles. About 6,000 square miles are suitable for cool-weather crops, 439,000 square miles for warm-weather crops, and 41,000 square miles for grazing only.

Land suitable for grazing only, covers about 41,000 square miles, 8 per cent of the area.

The agricultural exports are chiefly coffee, maize, sugar, palm kernels, palm oil, hides, and cotton. They amount to about $14.00 per square mile of land suitable for crop production.

The population density is 5.2 per square mile, or 5.6 if based on agricultural land. There are about 62 natives to one European.

BELGIAN CONGO

The Congo lies on the equator in the center of Africa and is drained by the Congo River. It is the second largest colony and has an area of 918,000 square miles (Figure 193). Except at the mouth of the Congo River, practically all of the area lies above 1,000 feet elevation and much of the southern and eastern portion above 2,000 feet. The highest land lies along the eastern border next to Lake Tanganyika, Lake Kivu, Lake Edward, and Lake Albert, and rises to 6,500 feet near Lake Kivu.

About 416,000 square miles, 45 per

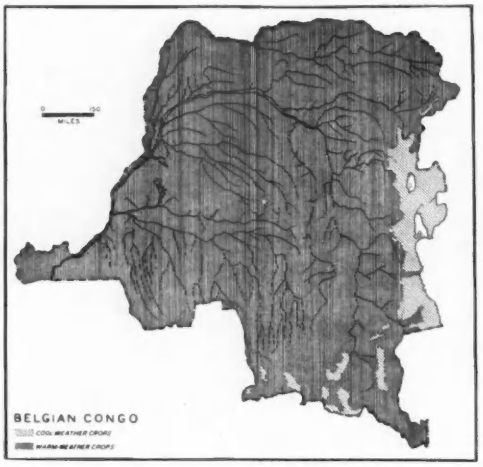

FIGURE 193.—The Belgian Congo has an area of 918,000 square miles. About 67,000 square miles are suitable for cool-weather crops, 842,000 square miles suitable for warm-weather crops, and 9,000 suitable for grazing only.

cent of the area, is tropical rain forest, forming a broad belt extending 300 miles on either side of the equator. This belt north of the equator extends from the foot of the highlands of the east boundary west to the Atlantic. The belt south of the equator is broken by a grassland west of Lake Leopold II. Here are great resources in timber and rubber. The land is also suitable for warm-weather tropical crops.

The high grass–low tree savanna, similar to the tropical rain forest as crop land, is valuable grazing land of high carrying capacity and covers about 334,000 square miles, or 36 per cent of the area.

On the eastern highland temperate rain forests cover about 11,000 square miles and are valuable for lighter timber and as cool-weather crop lands. Mountain grassland, similar to the temperate rain forest as crop land but unexcelled grazing land, covers about 56,000 square miles in the eastern and southern parts of the colony.

Dry forest of about 84,000 square miles lies in the east and south and with the acacia–tall grass savanna of 8,000 square miles is suited to the production of warm-weather crops, especially such crops as cotton and sorghum which require a drought period for ripening the crop. These lands are also valuable as grazing lands. Marsh grass along rivers and lakes probably covers about 9,000 square miles.

Land Use.—Forests cover about 427,000 square miles, or 47 per cent of the area. Probably the greatest value is in the oil palm, not strictly a forest tree but growing along rivers and openings. Rubber is probably next in importance produced by trees of Funtumia and vines of Landolphia. Timber of many kinds is produced, mostly cedar-like, mahogany-like, teak-like, and ebony-like woods, which await only a demand for their utilization.

Copal is an important gum produced in the tropical forest and kola nut is a valuable product, chewed by the African to relieve fatigue; it serves the same function as betel nut to the Hindu or opium to the Chinaman. It is used throughout the world as a beverage.

Woodlands occupy about 84,000 square miles, about 9 per cent, and produce wood, small timber, and rubber, and are valuable as grazing lands and for the production of warm-weather crops under cultivation.

Grazing lands of high carrying capacity cover about 491,000 square miles, 53 per cent of the total area. Of this area the forested part is less suitable for cattle, thus leaving for cattle grazing about 398,000 square miles, or 43 per cent of the total area. On these lands Europeans produce a few cattle, sheep, goats, pigs, horses, donkeys, and mules, and natives a larger number of goats, sheep, cattle, and pigs. The total production amounts to 599,000 animal units, only 1.2 per square mile of grazing land. Livestock production is very

low and crop production is the chief industry. This is largely due to diseases which may in time be controlled.

The wildlife resources of the Congo are very great. In the dense forests buffalo, elephant, okapi, and duiker, and hippopotamus along the rivers, and a wealth of birds, squirrels, and monkeys are common, while in the more open savanna many members of the antelope family and the rhinoceros, elephant, buffalo, zebra, and carnivora furnish abundant opportunity to sportsmen.

Land Classification.—Cool-weather crop land in the east and southeast amounts to about 67,000 square miles, about 7 per cent of the area. Here are produced coffee, bananas, and beans, the coffee chiefly by Europeans. Warm-weather crop land occupies 842,000 square miles, 92 per cent of the total area. Here Europeans produce chiefly coffee (*C. robusta*), oil palm (Figure 194), rubber, cacao, sisal, millet, maize, eleusine, manioc, bananas, yams, sweet potatoes, peas (Figure 195), beans, and groundnuts.

The natives produce chiefly manioc, maize (Figure 196), bananas, oil palm, cotton, beans, groundnuts, sweet potatoes, rice, sesame, millet and sorghum, and many other crops, and alas collect rubber, kola, and copal from the forests.

The land incapable of crop production amounts to about 9,000 square miles of marsh land.

The chief agricultural exports are palm nuts, cotton, palm oil, cacao, rubber, coffee, sesame, and hides, and amount to about $13.00 per square mile of agricultural land.

The population density is about 9.5 per square mile, or if based on agricultural land, 9.6 per square mile. There are 374 natives to one European.

FRENCH EQUATORIAL AFRICA

This is a large area of 912,000 square miles (Figure 197). It extends along the coast from the Belgian Congo on the south to Spanish Guinea on the north and extends inland to the Belgian Congo, then north to and including the Tibesti Mountains in the central Sahara. Along the coast and in the Bodele depression and the Tschad basin in the north the elevation is less than 1,000 feet. Much of the area is between 1,000 and 2,000 feet elevation but in the Gabon, the

FIGURE 194.—Oil palm (*Elaeis guineensis*) grows naturally over Central Africa. This shows a young planting. Kulu, Belgian Congo.

East Cameroon, and the Anglo-Egyptian border it rises to over 2,000 feet.

Rainfall varies from about 100 inches on the coast to a large area under 10 inches in the north.

The vegetation varies from heavy tropical rain forest to desert. Along the coast about 2,000 square miles is mangrove forest, and inland marsh grass covers about 7,000 square miles. On the upland next to the Cameroon, mountain grassland which is excellent grazing and cool-weather crop land covers about 6,000 square miles. Tropical rain forest occupies about 170,000 square miles, nearly 19 per cent of the total area. This is one of the most valuable forests in Africa, partly because of the accessibility of the forests of the Gabon. This land is also well suited to tropical warm-weather crops of all kinds.

The high grass–low tree savanna, similar to the forest for crop production

FIGURE 195.—Almost everywhere in Central Africa the pigeon pea (*Cajamus indicus*) is a prominent food plant. The stems are also used for fuel. Kongolo, Belgian Congo.

but also valuable as grazing land of high carrying capacity, covers 310,000 square miles. Acacia–tall grass savanna occupies about 128,000 square miles in a broad belt across the colony south and east of Lake Tschad. It is grazing land of high carrying capacity and adapted to warm-weather crops such as maize, sorghum, cotton, and groundnuts. In this area and along the Anglo-Egyptian border dry forest occupies about 9,000 square miles. It is grazing land, warm-

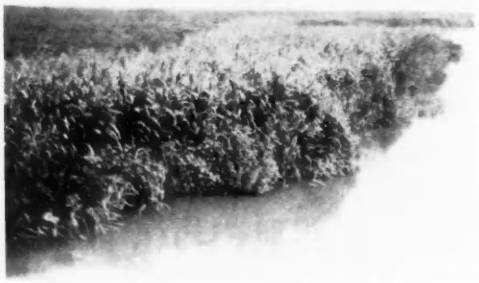

FIGURE 196.—The Lualaba flows through swamps of papyrus. Along the edge, silt collects to form natural levees. Here natives have planted a strip of maize which can be clearly distinguished by the lighter color. Uionga, Belgian Congo.

weather crop land, and valuable for wood and small timber.

North of this acacia–tall grass savanna lies the acacia–desert grass savanna, a belt about 100 miles wide south of the Sahara and covering about 88,000 square miles. This is good grazing land of low carrying capacity but is poorly adapted to crop production because of the semi-arid climate. More arid and of lower carrying capacity, the desert shrub–desert grass covers about 191,000 square miles. A very small amount of true desert of about 1,000 square miles completes the area.

Land Use.—Forests occupy about 172,000 square miles or about 19 per cent of the total area. Here the chief products are construction timber and cabinet woods such as khaya, okoume, noyer, ekhimi, abura, opepe, and ekki for which the Gabon is famous. There are also values in rubber, copal, kola, and oil palm. Woodlands are not extensive and cover about 15,000 square miles.The savanna country also produces wood, gums, and shea butter.

Grazing land of high carrying capacity covers 460,000 square miles or half of the area. Low carrying capacity grazing land amounts to 279,000 square miles, about 31 per cent of the area. Together they amount to 739,000 square miles, 81 per cent of the total area, suitable for sheep and goats. Probably cattle can use 723,000 square miles, 79 per cent of the area. This grazing land produces cattle, sheep, goats, donkeys, horses, camels, and pigs. The total production amounts to 1,265,000 animal units, or only 1.7 per square mile of grazing land.

The wildlife resources are great in this colony. Not only are the forest animals of the west African faunal region present but types of most of the savanna animals of the Saharan faunal region as well. Ivory, hippopotamus hides and teeth, hides of game animals, and a wildlife meat supply are important products of the land.

Land Classification.—Cool-weather crop land is limited to about 6,000 square miles. This would be suitable for Arabian coffee, bananas, and for temperate cereals. Warm-weather crop land amounts to 617,000 square miles or two-thirds of the area. Here are produced cacao, coffee (*C. robusta*), and vanilla by Europeans, and groundnuts, maize, sesame, tobacco, coffee, cacao, and rice by natives. In addition there should be included probably all the crops grown by natives in central Africa. Natives collect and sell palm oil and kernels, rubber, shea butter, copal, kola, and many other products. Land incapable of crop production and suitable for grazing only, covers about 289,000 square miles, nearly a third of the area. Here are the best areas for horses and camels and here is produced much of the animal export.

Agricultural exports are chiefly live animals, rubber, palm kernels, palm oil, and cacao. To this should be added ivory, copal, and construction and cabinet woods such as okoume, khaya, iroko, tigerwood, and many others. The exports here recorded amount to about $3.00 per square mile of agricultural land.

The population density is about 3.4 per square mile or, if based on agricultural land, is 5 per square mile. There are about 1,249 natives to each European.

SPANISH GUINEA AND FERNANDO PO

Spanish Guinea is a small area of about 10,000 square miles on the coast south of the French Cameroons (Figure 198). In the back country it rises to over 2,000 feet in elevation. About 9,000 square miles is tropical rain forest, and along the coastal lowlands there is about 1,000 square miles of high grass and low tree savanna.

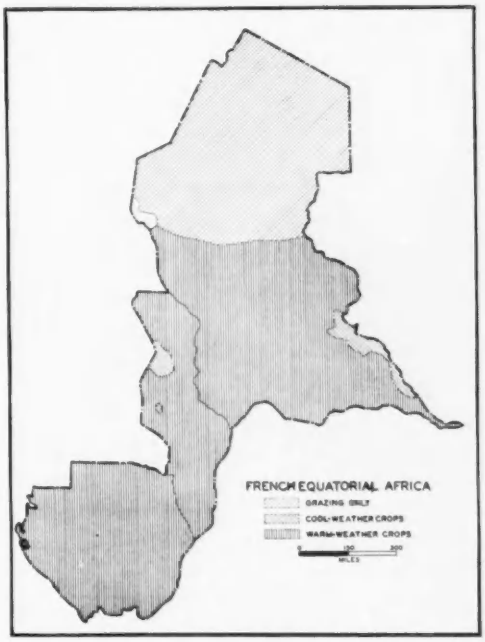

FIGURE 197.—French Equatorial Africa has an area of about 912,000 square miles. About 6,000 square miles are suitable for cool-weather crops, 617,000 square miles for warm-weather crops, and 289,000 square miles suitable for grazing only.

FIGURE 198.—Spanish Guinea has an area of about 10,000 square miles, all suitable for warm-weather tropical crops.

Fernando Po has an area of nearly 800 square miles. About 400 square miles are suitable for cool-weather crops and 400 square miles suitable for warm-weather crops.

Portuguese Guinea has an area of 22,000 square miles. About 17,000 square miles are suitable for warm-weather crops and about 5,000 square miles of mangrove swamp unsuitable for crop production.

Ifni has an area of 965 square miles suitable for grazing only, excepting where irrigated.

Spanish Morocco has an area of a little more than 18,000 square miles. The whole area is suitable for cool-weather crops.

Fernando Po, an island of 784 square miles rises from sea level to 9,185 feet elevation (Figure 198). About half of the area was tropical rain forest and half temperate rain forest and mountain grassland. Because of this high land it was very important in the early history of this part of Africa.

There is no record of the livestock. The principal crop is cacao. There are also produced oil palm, yams, manioc, rubber, and copra, and at higher elevations bananas, coffee, and potatoes.

The agricultural exports are chiefly cacao, with coffee, wool, and copra as minor products. The export amounts to $343.00 per square mile of agricultural land.

The population density of Spanish Guinea is 8.9 per square mile and there are 658 natives to one European. The population density on Fernando Po is 27 per square mile and there are 70 natives to one European.

FRENCH CAMEROON

The French Cameroon, the part of the German colony assigned to France as a mandate, is about 166,000 square miles in area and includes all but a strip of about 34,000 square miles along the northwest border which was mandated to Great Britain (Figure 199). Along the coast are wet lowlands with a rainfall of as high as 400 inches a year. The Cameroon Mountains rise to 13,353 feet elevation and much of the area lies above 2,000 feet. The highlands along the western edge turn east across the area about midway between the northern and southern extremity of the mandate.

Mangrove forests along the coast probably cover 1,000 square miles. The tropical rain forests are the most extensive type, covering 68,000 square miles or 41 per cent of the total area.

High grass–low tree savanna is next in area, the 66,000 square miles occupying 40 per cent of the total. Both of these types occupy land capable of producing warm-weather tropical crops. About 23,000 square miles is mountain grassland, excellent grazing land and cool-weather crop land. Acacia–tall grass savanna of 4,000 square miles and an equal amount of dry forest complete the area.

Land Use.—Forests cover 69,000 square miles, about 42 per cent of the area. These produce khaya, sapele, iroko, obeche, and many other woods for cabinet and construction work, tan bark, palm oil, kola, rubber, copal, and many other useful products.

Woodlands of about 4,000 square miles are found mostly in the north. To this should also be added the savanna trees which furnish wood, rubber, and shea butter.

About 97,000 square miles, 58 per cent of the area, is grazing land of high

carrying capacity, practically all suitable for cattle, goats, and sheep. Here are produced cattle, sheep, goats, horses, donkeys, and pigs. The total production amounts to 512,000 animal units, or 5.3 per square mile of grazing land. Game is abundant and ivory an important export.

Land Classification.—Cool-weather crop land, limited to about 23,000 square miles, 14 per cent of the total area, has developed a dense population which consumes much of its own production. On this land, cereals, bananas, potatoes, tobacco, Arabian coffee, and many fruits can be produced. Here are some of the best livestock areas.

Warm-weather crop land occupies 142,000 square miles, 85 per cent of the total area. Here are produced tobacco, oil palms, rubber, and coffee by Europeans, and groundnuts, cacao, sesame, cotton, oil palm, manioc, and bananas by natives. The coffee grown here is mostly of the Liberian and robusta species.

The principal agricultural exports are palm kernels, cacao, palm oil, rubber, and tobacco, amounting to $32.00 per square mile of agricultural land. To these exports should be added cabinet wood, construction timber, ivory, hides, and kola nuts.

The population density is about 11 per square mile and there are 950 natives to one European.

BRITISH CAMEROONS

A narrow strip of the Cameroons along the Nigerian border was allotted to Great Britain as a mandate. This area of about 34,000 square miles extends from the Atlantic coast to Lake Tschad (Figure 200). It is now administered as a part of Nigeria.

The vegetation consists of a mangrove forest of about 1,000 square miles, about 8,000 square miles of tropical rain forest, 12,000 square miles of high grass–low tree savanna, 4,000 square miles of acacia–tall grass savanna, and 9,000 square miles of mountain grassland.

Land Use.—About 9,000 square miles, 26 per cent of the area, is forest, valuable for cabinet and construction timber and for rubber, kola, copal, and other forest products.

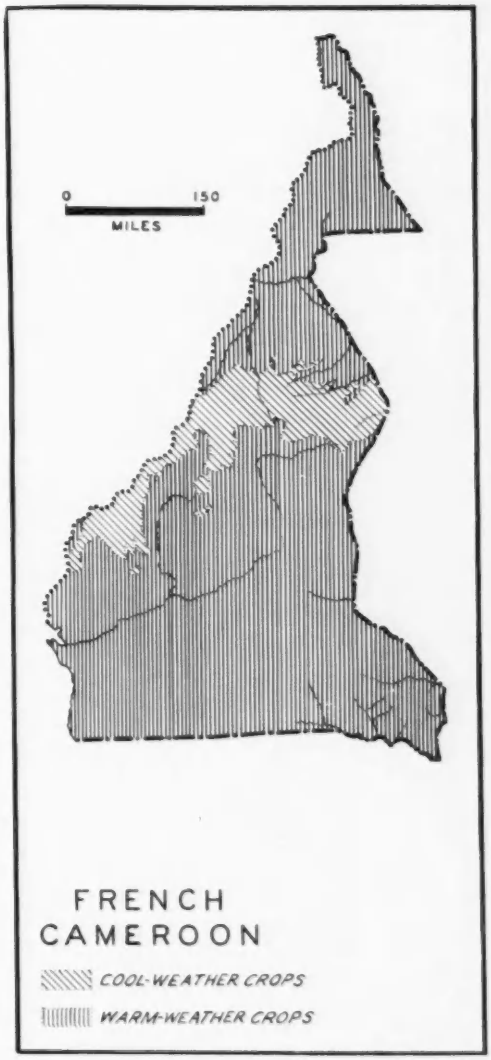

FIGURE 199.—The French Cameroon has an area of a little over 166,000 square miles. About 23,000 square miles are suitable for cool-weather crops, and 142,000 square miles for warm-weather crops.

About 25,000 square miles, nearly three-fourths of the area, is grazing land of high carrying capacity. Here are produced various types of domestic livestock. They are reported as part of Nigeria.

About 9,000 square miles, 26 per cent of the total area is cool-weather crop land, valuable for coffee (Arabian), bananas, beans, cereals, and more temperate fruits and vegetables. The natives produce sweet potatoes, beans, wheat, tobacco, and many other crops. Warm-weather crop land amounts to 24,000 square miles, 70 per cent of the area. The crops are chiefly cacao, oil palm, rubber, and bananas by Europeans, and by natives almost every crop such as millet, sorghum, cotton, groundnuts, manioc, sweet potatoes, yams, onions, maize, rice, tobacco, colocasia, sesame, and cacao.

FIGURE 200.—The British Cameroon has an area of a little over 34,000 square miles. About 9,000 square miles are suitable for cool-weather crops, and 24,000 square miles for warm-weather crops.

The principal agricultural exports are palm kernels, palm oil, cacao, and coffee, and these amount to about $57.00 per square mile of agricultural land.

The population density is about 20 per square mile and there are 3,045 natives to one European.

NIGERIA

Nigeria occupies 332,000 square miles north of the eastern portion of the Gulf of Guinea (Figure 201). Half of the area has an elevation of less than 1,000 feet. Along the eastern boundary, lands rise to over 2,000 feet elevation. The harmattan, a prevailing northeasterly wind from October to March during the dry season produces dust clouds not unlike those in the recently developed dust bowl of the southern high plains of the United States. This is one of the most distinctive features of the Nigerian climate.

Mangrove forests along the coast, especially in the Delta of the Niger River, cover about 2,000 square miles. Back of this is a tropical rain forest belt of about 41,000 square miles and beyond this, a high grass-low tree savanna covering 167,000 square miles. Another belt of acacia-tall grass savanna of 103,000 square miles lies north, and the savanna belts have scattered through them about 15,000 square miles of dry forest.

There is a small amount of mountain grassland of about 1,000 square miles and about 3,000 square miles of marsh grass.

Land Use.—Forests cover 43,000 square miles, 13 per cent of the total area, valuable for cabinet and construction timber, for rubber, palm oil, kola nut and various other forest products. About 15,000 square miles is woodland and to this should be added the trees of the savanna country, often especially

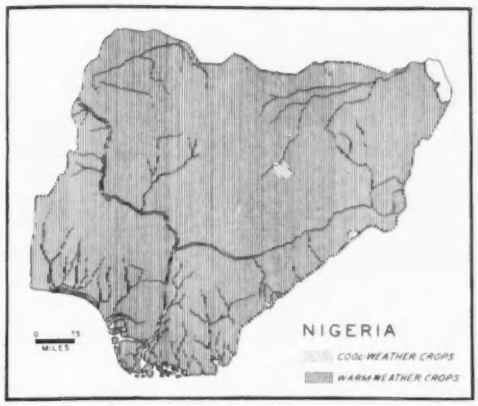

FIGURE 201.—Nigeria has an area of a little over 332,000 square miles. About 1,000 square miles are suitable for cool-weather crops, and 326,000 square miles suitable for warm-weather crops. About 5,000 square miles of marsh and mangrove have not been indicated in the figure.

valuable for timber, shea butter, gums, and rubber.

The grazing land amounts to 289,000 square miles, 87 per cent of the area. This is suitable for sheep and goats and all but about 15,000 square miles for cattle. Here are produced cattle, sheep, goats, donkeys, horses, pigs, camels, and a few ostriches and mules. The total production amounts to 5,082,000 animal units or 16 per square mile of grazing land.

Land Classification.—There is very little cool-weather crop land, probably not over 1,000 square miles. The whole colony lies in the warm-weather crop area, which occupies 326,000 square miles, 98 per cent of the total area. Here are produced a great variety of crops, chief among which are oil palm, groundnuts, cacao, cotton, sesame, rubber, copra, maize, colocasia, and food crops such as guinea corn, millet, rice, groundnuts, yams, sweet potatoes, potatoes, colocasia, beans, cowpeas, pigeon peas, okra, chillies, manioc, and maize.

The chief agricultural exports are palm kernels, palm oil, groundnuts, cacao, hides, skins, cotton, mahogany-like timber, rubber, cottonseed, sesame, fruit, and shea butter. These amount to about $226.00 per square mile of agricultural land. Important products gathered but sometimes not actually grown are rubber, palm kernels and oil, piassava fiber (raffia) (Figure 202), shea butter, and gum arabic.

The population density is about 54 per square mile and there are 3,766 natives to one European.

BRITISH TOGOLAND

This area of about 13,000 square miles has been combined with the Gold Coast, Ashanti, and Northern Territories for administration purposes (Figure 203). It is about the western third of Togoland.

Most of the area is high grass–low tree savanna of about 12,000 square miles. A small forest of tropical rain

FIGURE 202.—Raffia, a native palm, is used for fiber and material for the construction of huts and small buildings. Much of the fiber is exported as piassava fiber which it resembles. It is used in making mats, sacks, and by gardeners and nurserymen in tying up plants. Wusi, Kenya.

forest of about 1,000 square miles completes the land area.

Land Use.—The forest area is small and the resource in trees of the savanna country must be used to supply local needs.

Grazing land of about 12,000 square miles, 92 per cent of the colony, produces cattle, sheep and goats, horses, and donkeys. The total production amounts to 17,000 animal units or 1.4 per square mile of grazing land. The area is also productive of game animals.

Land Classification.—The 13,000 square miles, 100 per cent of the total area, is suitable for the production of warm-weather crops. These are principally the native food crops. There is no statistical material of agricultural production.

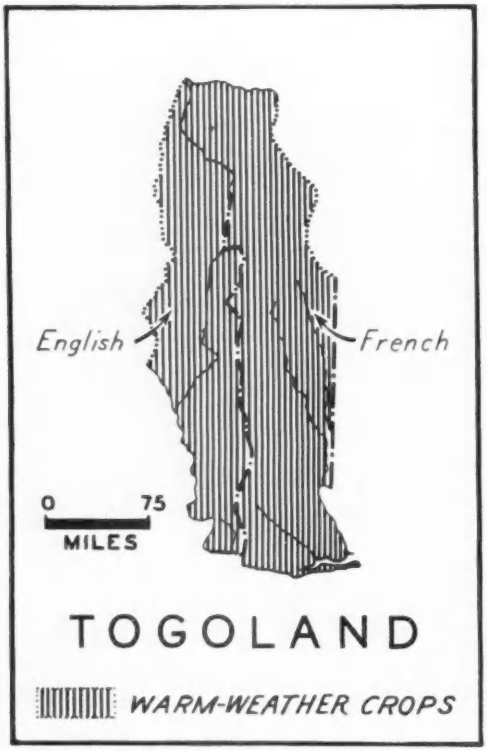

FIGURE 203.—British Togoland has an area of nearly 13,000 square miles all of which is suitable for warm-weather crops. French Togo has an area of about 22,000 square miles. About 21,000 square miles are suitable for warm-weather crops.

Exports are chiefly cacao, palm kernels, cotton, palm oil, and kola nuts, and amount to $79.00 per square mile.

The population density is 15 per square mile and there are 12,550 natives to one European.

FRENCH TOGOLAND

About two-thirds of Togoland or 22,000 square miles is a French mandate (Figure 203). This is the more varied part of the area and rises to 3,600 feet elevation.

Tropical rain forests of about 1,000 square miles are mostly along the rivers in the southern part. Marsh grass occupies about 1,000 square miles and dry forests about 3,000 square miles. Most of the country is a high grass-low tree savanna of 17,000 square miles.

Land Use.—The forest, of value for cabinet and construction timber, is limited and does not exceed 1,000 square miles. Woodlands cover about 3,000 square miles or the two together about 18 per cent of the total area.

Grazing land of high carrying capacity covers 21,000 square miles, 95 per cent of the area. The dry forest areas are less suitable for cattle. On the total grazing area are produced sheep, goats, cattle, pigs, horses, and donkeys. The total production amounts to 65,000 animal units or 3.1 per square mile of grazing land.

Big game is relatively abundant.

Land Classification—The whole area is suitable to the production of warm-weather crops. These are chiefly cotton and groundnuts. The natives produce as food crops maize, yams, beans, manioc, bananas, kola, coffee, oil palm, coconut, kapok, and other vegetables.

The chief agricultural exports are cacao, cotton, palm kernels, palm oil, copra, and maize and amount to about $152.00 per square mile of agricultural land.

The population density is about 27 per square mile and there are 1,025 natives to one European.

DAHOMEY

Dahomey lies between Togoland on the west and Nigeria on the east. It extends from the coast on the south to the Niger River on the north. In the central portion the land is over a thousand feet in elevation but both in the north and in the south the land lies less than a thousand feet above sea level.

The total area is 63,000 square miles (Figure 204). Swamp lands along the coast have mangrove forests, and inland swamps have marsh grass of about 1,000 square miles. A small area of about 2,000 square miles is tropical rain forest and in the north a relatively large area of 14,000 square miles is dry forest. In the south, high grass–low tree savanna occupies about 19,000 square miles and in the north the acacia–tall grass savanna occupies about 27,000 square miles.

Land Use.—Forests cover only about 2,000 square miles, 3 per cent of the area. Oil palm is an important resource but here also are cabinet woods and kola and wild rubber.

Woodland covers 14,000 square miles, about 22 per cent of the area. Small timber, cabinet wood, rubber, and shea butter are produced.

The grazing land amounts to 61,000 square miles, 97 per cent of the area. Except for the dry forest area this is suitable for cattle. The total area produces cattle, sheep, goats, pigs, horses, and donkeys. The total production amounts to 210,000 animal units or 3.4 animal units per square mile of grazing land.

Land Classification.—Warm-weather crop land covers 62,000 square miles, 98 per cent of the whole area. Here are produced cotton, coffee, oil palm, cacao, and castor bean by Europeans. Three types of coffee (Arabian, Liberian, and robusta) are grown. Natives produce cotton, groundnuts, millet, yams, manioc, beans, and oil palm.

The chief agricultural exports are palm kernels, palm oil, cotton, shea butter, cottonseed, castor beans, and groundnuts, amounting to $58.00 per square mile of agricultural land.

The population density is 17 per square mile and there are 1,056 natives to one European.

IVORY COAST

The Ivory Coast, with an area of 122,000 square miles lies, between the Gold Coast and Liberia, and is bounded

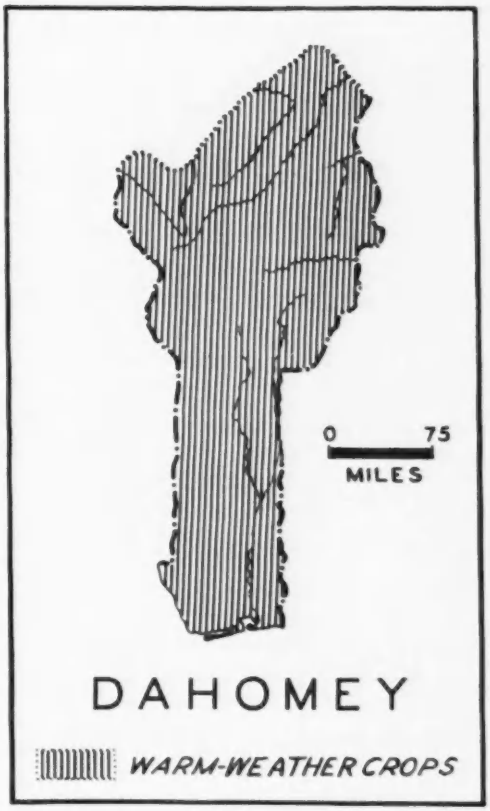

FIGURE 204.—Dahomey has an area of nearly 63,000 square miles and about 62,000 square miles are suitable for warm-weather crops.

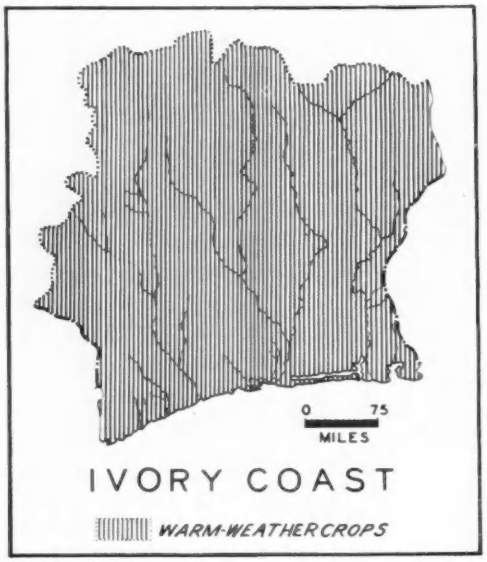

FIGURE 205.—The Ivory Coast has an area of about 122,000 square miles all of which are suitable for warm-weather crops.

on the north by the Upper Volta and the French Sudan (Figure 205). The southeast portion is less than 1,000 feet in elevation but the west rises to over 5,000 feet near the French Guinea border. The drainage is into the Gulf of Guinea except in the northwest, where the drainage is mostly into the Niger.

It is divided almost equally into tropical rain forest of 60,000 square miles and high grass–low tree savanna of 62,000 square miles. There is a very small area of mountain grassland in the west.

Land Use.—Forests occupy 60,000 square miles, 49 per cent of the area. Here are produced many valuable timber trees such as khaya, sapele, niangon, bitterwood, guarea, iroko, avodire, and obeche, besides oil palm, copal, rubber, and kola.

Grazing lands of high carrying capacity cover about 62,000 square miles, 51 per cent of the area. Here are produced cattle, sheep, goats, pigs, and horses. The total produced, measured in animal units, amounts to 131,000, or 2.1 per square mile of grazing land.

Land Classification.—Warm-weather crop land covers the whole colony of 122,000 square miles. Here Europeans produce cacao, coffee, kola, sisal, and oil palm, and natives produce rice, cotton, cacao, coffee, groundnuts, manioc, bananas, maize, and sweet potatoes.

The principal agricultural exports are cacao, palm kernels, palm oil, cotton, coffee, and rubber. Cabinet woods and bananas are also exported. The value of the exports amounts to about $51.00 per square mile.

The population density is 14 per square mile and there are 1,067 natives to one European.

GOLD COAST, ASHANTI, AND NORTHERN TERRITORIES

The combined area is about 79,000 square miles which lies between the Ivory Coast on the west and Togo on the east and extends from the Gulf of Guinea to the Upper Volta (Figure 206). Most of the land is under 1,000 feet elevation.

A small amount of mangrove and about 1,000 square miles of marsh grass are non-crop-producing lands.

Tropical rain forests, mostly in the Gold Coast, occupy about 20,000 square miles. A very small area of about 1,000 square miles is of dry forest. High grass–low tree savanna covers 57,000 square miles and is good grazing land and warm-weather crop land.

Land Use.—Forests cover 20,000 square miles, about one-fourth of the area, and contain cabinet and construction woods such as ikhimi, obeche, ekke, kaya, niangon, and iroko. A small amount of woodlands and timber in the savanna is important and adds to

the forest products of rubber, oil palm, shea butter, and kola.

Grazing lands of high carrying capacity cover 59,000 square miles, three-fourths of the area. Here are produced cattle, sheep, pigs, donkeys, and horses. The total production amounts to 218,000 animal units or 3.7 animal units per square mile of grazing land.

Land Classification.—Land suitable for the production of warm-weather crops covers 78,000 square miles or nearly the whole area. Here are produced cacao, oil palms, kola, coconuts, rubber, sisal, and such food crops as maize, yams, manioc, colocasia, sweet potatoes, groundnuts, bananas, rice, tobacco, and coffee.

The principal agricultural exports are cacao, cabinet woods, kola nuts, palm kernels, rubber, copra, hides, skins, and palm oil. These amount to about $625.00 per square mile of agricultural land in the colony.

The population is 25 per square mile and there are 1,130 natives to one European.

LIBERIA

Liberia covers 43,000 square miles and lies between the Ivory Coast and Sierra Leone (Figure 207). It is an independent country. About half of the area is less than 1,000 feet in elevation and the other half lies mostly between 1,000 and 2,000 feet elevation. Rainfall varies from 150 inches a year at the coast to 80 inches in the back country.

Along the coast about 8,000 square miles is high grass–low tree savanna. Back of this lies about 35,000 square miles of tropical rain forest.

Land Use.—The forests cover 35,000 square miles, 81 per cent of the area. Here are trees of value but the timber resources are not utilized.

About 8,000 square miles, 19 per cent, is grazing land of high carrying capacity but few animals are raised. There are a few goats, but sheep and cattle are rare.

Warm-weather crop land includes the whole area of 43,000 square miles. Here rubber is being produced on plantations managed by an American company. The natives produce rice, manioc, yams, bananas, maize, beans, groundnuts, sweet potatoes, and sugar cane.

The principal agricultural exports are palm kernels, coffee (Liberian), manioc,

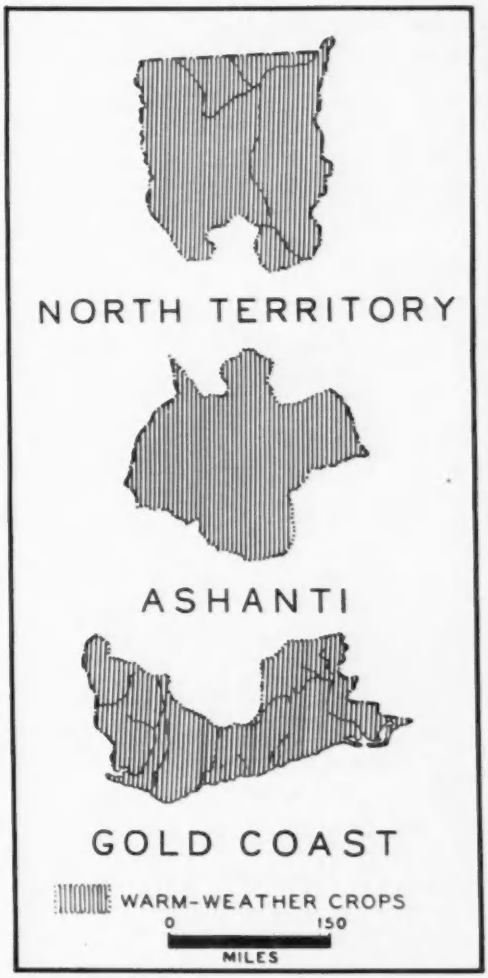

FIGURE 206.—Gold Coast, Ashanti, and Northern Territory have an area of about 79,000 square miles, of which all but about 1,000 square miles of marsh is suitable for warm-weather crops.

palm oil, rubber, and cacao. These amount to about $38.00 per square mile.

The population density is about 52 per square mile.

SIERRA LEONE

Sierra Leone on the Atlantic Ocean is bounded on the north and east by French Guinea and on the southeast by Liberia. The area is about 31,000 square miles (Figure 207). The coast is low and swampy and about half of the area lies under 1,000 feet elevation. The plateau has an average elevation of about 1,600 feet but rises near the French Guinea frontier to 6,000 feet. Rainfall varies from about 150 inches at the coast to 80 inches in the back country.

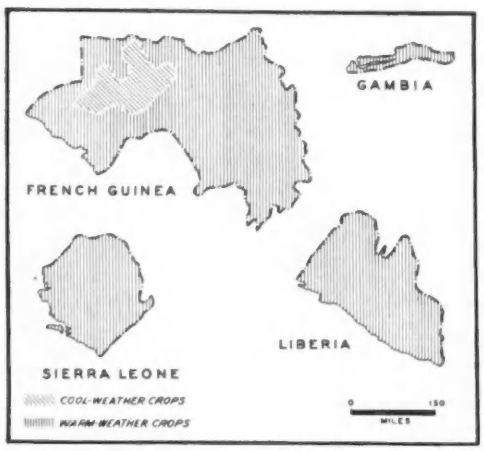

FIGURE 207.—Liberia has an area of 43,000 square miles, all of which are suitable for warm-weather crops.

Sierra Leone has an area of about 31,000 square miles. Except for 2,000 square miles of mangrove swamp not shown in the figure, the remaining area of 29,000 square miles is suitable for warm-weather crops.

French Guinea has an area of nearly 93,000 square miles. About 9,000 square miles are suitable for cool-weather crops, 83,000 square miles are suitable for warm-weather crops, and about 1,000 square miles of mangrove swamp are unsuited to crop production.

Gambia has an area of about 4,000 square miles. About 3,000 square miles are suitable for warm-weather crops, and 1,000 square miles are of mangrove swamp unsuited to crop production. Mangrove areas are small and have not been indicated in the figures.

About 2,000 square miles of mangrove forest along the coast are valuable for timber and tan bark. Tropical rain forests occupy about 8,000 square miles, mostly near the coast.

The high grass–low tree savanna covers about 21,000 square miles. The whole area is warm and humid and adapted to warm-weather tropical crops.

Land Use.—Forests occupy about 10,000 square miles, or nearly a third of the area. Although forests are important, except for oil palm, kola and piassava (raffia), they do not appear prominently in the exports.

Grazing land occupies 21,000 square miles or two-thirds of the area. Here are produced cattle, sheep, goats, pigs, and a few horses, donkeys, and mules. The total amounts to 48,000 animal units or 2.3 units per square mile of grazing land.

Land Classification.—Except for the mangrove swamps, the remaining area of 29,000 square miles is warm-weather crop land. Here are produced cacao, rice, manioc, ginger, kola, groundnuts, chillies, sesame, and robusta coffee, and partly as natural crops, oil palm, raffia, and kola.

The principal agricultural exports are palm kernels, kola nuts, palm oil, ginger, manioc, chillies, hides, cacao, sesame, and raffia. These amount to $221.00 per square mile of agricultural land.

The population density is 50 per square mile, or if limited to agricultural land, 53 per square mile. There are 1,384 natives to one European.

FRENCH GUINEA

French Guinea with an area of 93,000 square miles includes some of the best agricultural and grazing land in West Africa (Figure 207). It lies between Portuguese Guinea and Sierra Leone and extends back of Sierra Leone and Liberia across to the Ivory Coast

colony. Except along the coast, the country lies at a relatively high elevation, exceeding 2,000 feet. All of the back country drains into the Niger. Rainfall varies from about 140 inches at the coast to 40 inches in the back country.

Mangrove forest is 1,000 square miles in extent; tropical rain forests, widely scattered, cover about 5,000 square miles, and dry forest about 1,000 square miles.

The mountain grassland, which is cool-weather crop land and grazing land, covers about 9,000 square miles. The high grass and low tree savanna is most extensive, occupying 77,000 square miles or 83 per cent of the colony.

Land Use.—Forests occupy 6,000 square miles or about 6.5 per cent of the area, and there are in addition probably 1,000 square miles of woodland and many valuable trees scattered through the savanna. Palm oil, shea butter, kola, copal, and gum arabic are valuable products of the forest and tree growth.

The grazing land is all of high carrying capacity. It occupies about 87,000 square miles, 94 per cent of the total area. Here cattle, sheep, goats, pigs, horses, and donkeys are produced. The production amounts to 543,000 animal units or 6.2 per square mile of grazing land.

Land Classification.—Cool-weather crop land at high elevation occupies about 9,000 square miles, about 10 per cent of the total area. Here is land suitable to the production of Arabian coffee and bananas and many other crops which thrive best where the temperatures are not high. Warm-weather crop land occupies 83,000 square miles, 89 per cent of the total area. Here are produced chiefly groundnuts, tobacco, sesame, cotton, sorghum, maize, sweet potatoes, and manioc.

The principal agricultural exports are palm kernels, hides, groundnuts, rubber, bananas, cattle, and sesame. These amount to about $27.00 per square mile of agricultural land.

The population density is 24 per square mile and there are 1,043 natives to one European.

PORTUGUESE GUINEA

This is a small area of about 22,000 square miles, lying between Senegal on the north and French Guinea on the south. Many small islands lie off the coast.

Mangrove forests occupy about 5,000 square miles on the islands and along the coast. A small area, probably 2,000 square miles, is tropical rain forest, but the greater part is high grass–low tree savanna, covering about 15,000 square miles.

Land Use.—About 7,000 square miles, 32 per cent of the area, can be classed as forest. Most of this has been partially exploited, but is still valuable as a source of timber and tanbark.

About 15,000 square miles, 68 per cent, is grazing land of high carrying capacity. Here are produced cattle, goats, pigs, sheep, donkeys, and horses. There are 114,000 animal units produced or 7.6 per square mile of grazing land.

Land Classification.—About 17,000 square miles, 77 per cent of the total area, is suitable for warm-weather crops. Here Europeans produce oil palm and sugar cane and natives produce groundnuts, rice, sugar cane, millet, manioc, and sweet potatoes.

The chief agricultural exports are groundnuts, copra, hides, palm oil, rubber, and beeswax. These amount to $89.00 per square mile of agricultural land.

The population density is 16 per

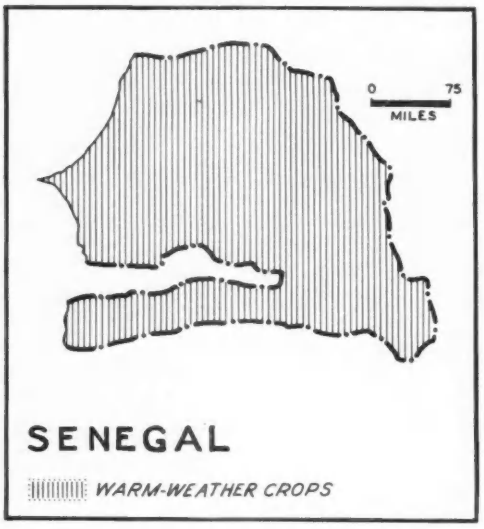

FIGURE 208.—Senegal has an area of a little over 74,000 square miles. About 73,000 square miles are suitable for warm-weather crops and 1,000 square miles are mangrove swamps.

square mile, or, if based on agricultural land, 20 per square mile.

GAMBIA

Gambia has an area of nearly 4,000 square miles along the estuary of the Gambia River (Figure 207). Mangrove forests occur in the brackish swamps and tropical rain forests farther inland. About half of the area is high grass–low tree savanna.

The forests, useful for tanbark and timber, occupy about half of the area.

Half of the area is grazing land, and cattle and other native livestock are raised but not for market.

Warm-weather crops can be produced on about three-fourths of the area. They are chiefly groundnuts, maize, sorghum, rice, and sweet potatoes.

The principal exports are groundnuts, palm kernels, and hides which amount to about $1,271.00 per square mile of agricultural land.

The population density is 53 per square mile, or if limited to agricultural land only, 70 per square mile. There are 975 natives to one European.

SENEGAL

Senegal with an area of 74,000 square miles occupies the territory between Portuguese Guinea on the south and Mauretania on the north with the exception of Gambia which is bounded on three sides by Senegal (Figure 208).

Mangrove forests cover about 1,000 square miles on the southwest coast. There are also about 2,000 square miles of tropical rain forest in the southern part.

The high grass–low tree savanna which covers about 18,000 square miles in the south is valuable as grazing land and as warm-weather crop land. A large part of the area is acacia–tall grass savanna of about 53,000 square miles, admirably adapted to warm-weather crops such as sorghum, cotton, and groundnuts, and is also good grazing land.

Land Use.—Forests cover about 3,000 square miles, 4 per cent of the area. The produce is tanbark and a small amount of cabinet wood. There are also forest products such as palm oil, gum arabic, rubber, and shea butter which come mostly from the trees of the savanna.

Grazing land of high carrying capacity occupies 71,000 square miles or 96 per cent of the total area. Here are produced cattle, sheep, goats, donkeys, horses, pigs, and camels, which amount to 652,000 animal units or 9.2 animal units per square mile of grazing land.

Land Classification.—Warm-weather crop land occupies 73,000 square miles, 99 per cent of the total area. Here Europeans produce sisal, manioc, groundnuts, hemp, fruits, and castor beans. Native production is chiefly food crops such as millet (probably Guinea corn or sorghum), rice, maize,

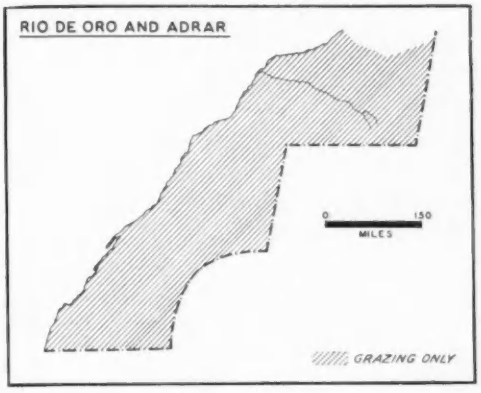

FIGURE 209.—Rio de Oro and Adrar have an area of about 109,000 square miles. There is no crop land, the whole area being suitable for grazing only.

and manioc, and as money crops groundnuts, rice, and cotton.

The principal agricultural exports are groundnuts, hides, cotton, oil seed, and palm kernels. To this should also be added skins, gum arabic, rubber, and shea butter. The total value amounts to $347.00 per square mile of agricultural land.

The population density is 18 per square mile and there are 283 natives to one European.

RIO DE ORO AND ADRAR

This large area of desert land of about 109,000 square miles is covered with desert shrub–desert grass (Figure 209). It is probable that lack of surface water, rather than absence of forage, accounts for the uninhabitable condition of the colony.

A small area of true desert covers about 1,000 square miles. The total area is grazing land of very low carrying capacity and the country is almost uninhabited.

Less than 500 people occupy the colony and these depend mostly on fishing for a livelihood.

IFNI

Ifni is a small area of 965 square miles on the coast of Morocco. It is chiefly a fishing port but due to irrigation there are produced dates, citrus, olives, garden vegetables, and honey. The grazing land is desert shrub used by a few sheep and goats.

The population is 21 per square mile and depends largely upon fishing for a living.

SPANISH MOROCCO

This area of about 18,000 square miles including Tangier lies in the northwestern portion of the continent.

Oak-conifer types of woodland occupy about 3,000 square miles, the temperate brush about 1,000 square miles, and the dwarf palm–temperate grass about 14,000 square miles. The forests are oak conifer, producing cork and wood for local consumption. They cover about 4,000 square miles, 22 per cent of the area.

The whole area can be grazed but there is no record available of the number of animals. It is also land suitable for the production of cool-weather crops and warm-weather crops during midsummer. No record of production could be found.

The exports are chiefly eggs, hides, skins, birdseed, and chick pea, and amount to about $9.80 per square mile.

The population density is 34 per square mile and there are 40 natives to one European.

MOROCCO

Except for Spanish Morocco and Ifni, French Morocco occupies the northwest portion of the continent. The area is 200,000 square miles (Figure 210). It includes the highest areas of north Africa and rises at one place to 14,764 feet.

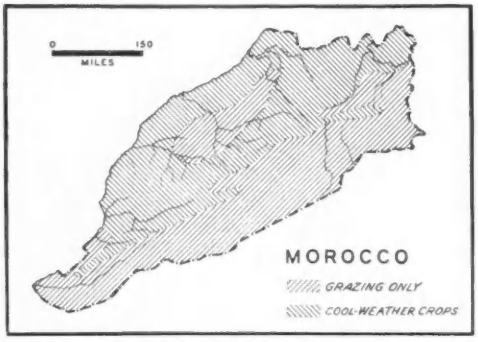

FIGURE 210.—Morocco has an area of 200,000 square miles. About 66,000 square miles are suitable for cool-weather crops, 27,000 square miles for warm-weather crops, and 107,000 square miles are suitable for grazing only.

Oak-conifer forests cover about 13,000 square miles scattered widely along the Atlas Mountains. Temperate-brush, probably representing in some of the area land previously forested, covers about 55,000 square miles. At lower elevation dwarf palm–temperate grass occupied 31,000 square miles, much of which is now in grain fields and pasture land. About 5,000 square miles here listed as acacia–desert grass savanna lies along drainage channels and areas which receive some flood water irrigation. Desert shrub and desert grass cover 96,000 square miles, mostly in the southeastern portion.

Land Use.—The forests cover about 7,000 square miles, 3.5 per cent of the area. Cork, cedar, arar tree, and various conifers are produced. Woodlands occupy about 66,000 square miles or a third of the area. Much of this is brushland of some value as goatfeed.

About 31,000 square miles is grazing land of high carrying capacity. Much of this has been converted into grain fields. Low carrying capacity grazing land covers 169,000 square miles. Practically the total area of 200,000 square miles can be grazed. Here Europeans produce cattle, sheep, pigs, goats, horses, mules, donkeys, and camels, and natives produce much larger numbers of sheep, goats, cattle, donkeys, horses, camels, mules, and pigs. The total production in animal units is 5,428,000 or 27 per square mile.

Land Classification.—Cool-weather crop land occupies 66,000 square miles or a third of the total area. Here Europeans produce wheat, oats, barley, peas, and beans, and natives produce barley, wheat, beans, and coriander. Warm-weather crop land of about 27,000 square miles, 14 per cent of the area, is better adapted to olives and citrus fruits, and such crops as maize, sorghum, chick pea, almonds, dates, citrus, olives, and vines are produced. The separation of warm-weather crops and cool-weather crops cannot be made on an area basis in the Mediterranean region. One or the other may predominate in a particular area, but as a rule on the same land either can be fitted into the period of the year which is most favorable for its growth. Citrus fruits are sometimes shut out by temperatures which fall too far below 28 degrees F.

A large area, 107,000 square miles, 53 per cent of the area, is incapable of crop production and is suitable for grazing only. Here are produced cattle, horses, camels, goats, and sheep, which contribute to the agricultural wealth of the country.

The principal agricultural exports are barley, wheat, eggs, wool, almonds, skins, olive oil, maize, and beans. They are valued at about $480.00 per square mile of agricultural land.

The population density is about 21 per square mile, or if estimated on the basis of crop land only, about 51 per square mile. There are 39 natives to one European.

ALGERIA

This large colony of 848,000 square miles between Tunis on the east and

Morocco on the west is a great desert domain except for the plains and mountains of the north (Figure 211).

Oak-conifer forests of about 10,000 square miles lie on the mountains of the north. Temperate brush characterizes about 27,000 square miles. The more level valleys and plateaus north of the mountains were formerly dwarf palm-temperate grass areas covering about 23,000 square miles.

Semi-desert areas of acacia–desert grass savanna cover about 19,000 square miles. Here are included the alfa plains.

In the desert portion, oases or areas of sub-irrigation or areas irrigated by flood water such as the better drainage channels in the eastern half of the colony, are classed as oases and estimated at about 4,000 square miles. A sparse desert growth, the desert shrub–desert grass, covers about 606,000 square miles. Desert, the more extreme type with little or no sustained plant cover, covers about 159,000 square miles.

Land Use.—About 5,000 square miles is forest, valuable for wood and small timber, cork and tanbark. Woodlands cover about 32,000 square miles or 4 per cent of the area. This type is productive of cork and is of some value for browse.

Grazing lands of high carrying capacity which covered 23,000 square miles, or 3 per cent of the area, have been replaced for the most part by cereal crops. Land of low carrying capacity covers 662,000 square miles, 78 per cent of the area. Much of this area is practically useless. The total area is 685,000 square miles, 81 per cent of the colony. It produces under European ownership, sheep, cattle, pigs, goats, mules, horses, donkeys, and camels, and under native ownership, sheep, goats, cattle, donkeys, camels, horses, and mules. The total production is 3,732,000 animal units, or 5.4 per square mile of grazing land.

FIGURE 211.—Algeria has an area of nearly 848,000 square miles. About 42,000 square miles are suitable for cool-weather crops, 17,000 square miles for warm-weather crops, and 789,000 square miles for grazing only.

Land Classification.—Warm-weather crops can be grown on the brushland and oases which covered about 17,000 square miles, 2 per cent of the total area. Here are produced dates, olives, citrus fruits, maize, cotton, bananas, and many warm-weather fruits and vegetables. Cool-weather crops can be grown best on about 42,000 square miles or 5 per cent of the area, but can also be grown as winter crops on the other lands. The principal crops are wheat, oats, barley, peas, maize, potatoes, tobacco, beans, and chick pea grown by Europeans, and barley, wheat, oats, beans, tobacco, sorghum, chick pea, maize, and peas grown by natives. There are also gardens, orchards, and vineyards where olives, dates, bananas, figs, pomegranates, almonds, citrus, vines, and vegetables such as artichoke and onions are produced.

Land suitable for grazing only, covers about 789,000 square miles or 93 per cent of the area. At least 158,000 square miles of this is practically worthless.

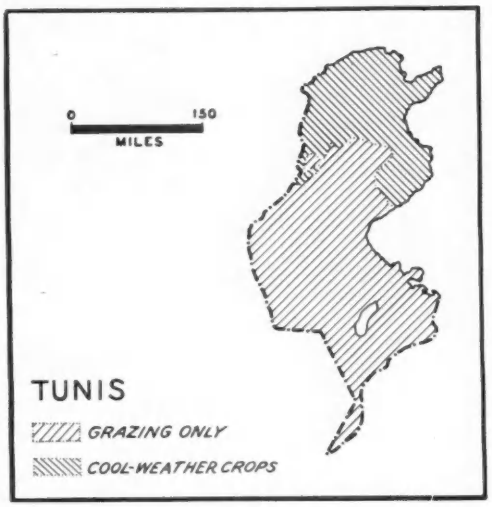

FIGURE 212.—Tunis has an area a little larger than 48,000 square miles. About 12,000 square miles are suitable for cool-weather crops, 5,000 square miles for warm-weather crops, and 31,000 square miles for grazing only.

On much of the area livestock does well and on the high plateau on which lies the Shott el Shergui, alfa (esparto) is an important natural product.

The principal agricultural exports are wine, wheat, barley, sheep, wheat flour, dates, oats, potatoes, and peas, and amount to about $2,222 per square mile of agricultural land.

The population density is 7.2 per square mile and if only land capable of crop production is considered, 103 per square mile. There are about 6 natives to one European.

TUNIS

Tunis has a typical Mediterranean climate in the north, and the south is a part of the Sahara. The area is 48,000 square miles (Figure 212).

Oak-conifer forests occupied about 2,000 square miles, temperate brush covered about 9,000 square miles, and the dwarf palm–temperate grass about 6,000 square miles. A great part of these areas has been converted into crop land. In the south, oases are irrigated or sub-irrigated lands which approximate 1,000 square miles in area.

Acacia–desert grass savanna of 1,000 square miles and desert shrub–desert grass of 18,000 square miles are grazing lands of low carrying capacity. There are about 11,000 square miles of true desert.

Land Use.—The forests of about 1,000 square miles, mostly in the west and on the more rugged mountains, produce some wood and timber. Woodlands of about 10,000 square miles, 20 per cent of the area, produce cork, wood, and browse.

Grazing lands of high carrying capacity covering 6,000 square miles, 13 per cent of the area, have been converted into crop lands for the most part. The grazing lands of low carrying capacity occupy about 30,000 square miles, 63 per cent of the area. This land also produces alfa for export. This area of grazing land, 36,000 square miles, or three-fourths of the total area, produces under European ownership, sheep, cattle, goats, pigs, mules, horses, donkeys, and camels, and under native ownership, sheep, goats, cattle, donkeys, camels, horses, and mules. The total amounts to 1,359,000 animal units or 38 per square mile of grazing land.

Land Classification.—Cool-weather crop land covering 12,000 square miles and warm-weather crop land 5,000 square miles in extent constitute 35 per cent of the total area. Cool-weather crops can be grown in winter and some of the warm-weather crops in summer. Here are grown wheat, vines, oats and barley, beans, sorghum, maize, peas, flax, potatoes, tobacco, olives, dates, almonds, citrus, and carob. Many other crops are grown by both Europeans and natives. About 31,000 square miles, two-thirds of the area, is grazing land only.

The principal agricultural exports

are wheat, barley, olive oil, wine, skins, beans, alfa, wool, and dates. The exports amount to about $1,902.00 per square mile of agricultural land.

The population density is 45 per square mile or, if based on agricultural land only, 127 per square mile. There are 11.5 natives to one European.

MAURETANIA

Mauretania, with an area of 347,000 square miles, extends from Algeria to Senegal and is bounded on the west by Rio de Oro, and Adrar and the Atlantic Ocean (Figure 213). Except for the extreme south it is a desert land.

Acacia–tall grass savanna covers about 20,000 square miles in the extreme south. This is the only agricultural land in the colony and the only grazing land of high carrying capacity. A belt of acacia–desert grass savanna covers about 45,000 square miles. A sparse vegetation, the desert shrub–desert grass occupies the greater part of the colony or 188,000 square miles. Desert, almost barren, covers 94,000 square miles.

Land Use.—There are no forests and only about 20,000 square miles, 6 per cent of the area, is grazing land of high carrying capacity. The total area of grazing land of high carrying and low carrying capacity is 253,000 square miles, about 73 per cent of the area. Here are produced sheep, goats, cattle donkeys, camels, and horses. The total production amounts to 891,000 animal units or 3.5 per square mile of grazing land.

Land Classification.—About 20,000 square miles, 6 per cent, is warm-weather crop land, subject to drought but valuable for the production of cereals and cotton. The production is chiefly maize, millet (probably sorghum), rice, and groundnuts.

Land suitable to grazing only covers 327,000 square miles, or 94 per cent, of which about 94,000 is non-productive.

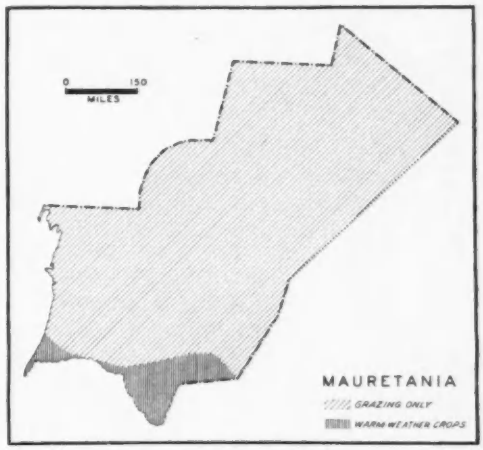

FIGURE 213.—Mauritania has an area of a little over 347,000 square miles. Of this area about 20,000 square miles are suitable for warm-weather crops, and 327,000 square miles for grazing only.

There is no detailed information available on exports.

The population density is about 0.8 per square mile or if only the land capable of crop production is considered, it is 14 per square mile. There are about 1,036 natives to one European.

FRENCH SUDAN

The French Sudan with an area of 360,000 square miles lies east and south of Mauretania and includes much of the upper Niger basin (Figure 214).

In the extreme south next to the Ivory Coast border high grass–low tree savanna covers about 43,000 square miles and is high carrying capacity grazing land and warm-weather crop land suitable for tropical crops. North of this lies 59,000 square miles of acacia–tall grass savanna, valuable as grazing land and a cotton and warm-weather cereal land.

Acacia–desert grass savanna land, 68,000 square miles in area, forms a third belt of land suitable for grazing but of

low carrying capacity and not suitable for crop production. Desert shrub–desert grass occupies most of the northern part of the colony, and covers 118,000 square miles. It is grazing land of low carrying capacity.

A desert area of 67,000 square miles lies mostly in the northwest. In the northern half, thickets of thorn forest cover about 2,000 square miles and dry forest an equal area in the acacia–tall grass belt. Marsh grass, 1,000 square miles in extent, completes the area.

Land Use.—There are about 4,000 square miles of woodland. In addition, the trees of the savanna country are valuable for wood, timber, oil, rubber, and gum production. Especially valuable are gum arabic and shea butter (kariti).

Grazing land of high carrying capacity occupies an area of about 104,000 square miles, 29 per cent of the area. Grazing land of low carrying capacity covers about 188,000 square miles, 52 per cent of the area. Together the grazing area is 292,000 square miles or 81 per cent of the total area. Here are produced sheep, goats, cattle, donkeys, horses, and camels. The total production amounts to 2,005,000 animal units or 6.9 per square mile of grazing land. Wild game animals are important in much of the area.

Land Classification.—Land capable of producing warm-weather crops has an area of 104,000 square miles, 29 per cent of the area. The southern part is especially adapted to tropical crops such as oil palm, manioc, sesame, and rice, while the northern part is better adapted to sorghum, groundnuts, and cotton. The principal crops here are groundnuts, cotton, sorghum, millet, maize, sisal, hemp, sesame. Extensive irrigation projects have been undertaken in the Niger Bend country.

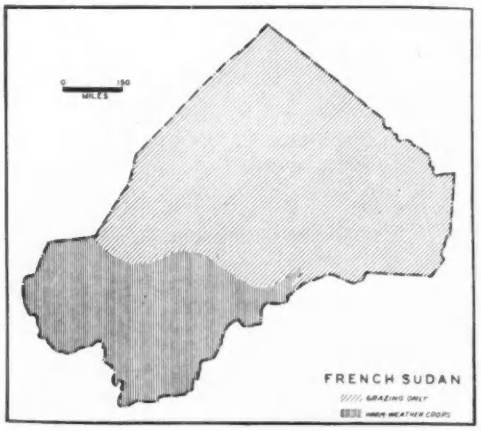

FIGURE 214.—The French Sudan has an area of a little over 360,000 square miles. About 104,000 square miles are suitable for warm-weather crops, and 256,000 square miles for grazing only.

Land suitable for grazing only, covers 256,000 square miles or about 72 per cent of the colony and is unsuited to crop production. Of this area about 67,000 square miles, 19 per cent, is useless as grazing land because of the sparse plant cover.

The principal agricultural exports are groundnuts, shea butter, hides, cotton, and skins, and amount to only $1.70 per square mile of land capable of crop production.

The population density is 7.3 per square mile, or if based only on land capable of crop production it is 25 per square mile. There are 1,448 natives to one European.

UPPER VOLTA

The Upper Volta, an area of 143,000 square miles, lies south of the French Sudan and north of Dahomey, Togoland, Northern Territories, and Ivory Coast (Figure 215). Much of the area has an elevation of over 1,000 feet.

High grass–low tree savanna, 41,000 square miles in area, covers the southern part of the colony. This is grazing land of high carrying capacity and suitable

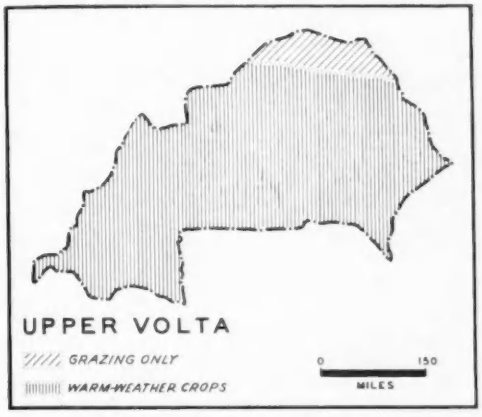

FIGURE 215.—The Upper Volta has an area of nearly 143,000 square miles. About 132,000 square miles are suitable for warm-weather crops, and 11,000 square miles for grazing only.

for the production of warm-weather tropical crops. North of this is a belt of acacia–tall grass savanna of 90,000 square miles which is also grazing land of high carrying capacity and suitable for warm weather cereals, cotton, and groundnuts. In this area thickets of trees, dry forest, cover about 1,000 square miles.

In the north acacia–desert grass savanna, 11,000 square miles in area, is grazing land of low carrying capacity but unsuited to crop production.

Land Use.—There are no forests, but woodlands and scattered savanna trees furnish forest products. These are wood and small timber, shea butter, gum arabic, oil, and rubber.

Grazing land of high carrying capacity occupies 132,000 square miles, 92 per cent of the area. Low carrying capacity land, 11,000 square miles in area, gives a total of 143,000, 100 per cent of the colony as grazing land. Here are produced goats, cattle, sheep, donkeys, horses, pigs, and a few camels. The production amounts to 730,000 animal units or 5.1 units per square mile.

Land Classification.—Warm-weather crops can be grown on 132,000 square miles, 92 per cent of the total area. Here are produced millet (probably guinea corn), maize, beans, pennisetum, rice, sweet potatoes, yams as food crops, and groundnuts and cotton as money crops.

About 11,000 square miles, 8 per cent, is unsuited to crop production but is good grazing land of low carrying capacity.

The principal agricultural exports are cattle, sheep, donkeys, shea butter, horses, and skins, amounting to $5.40 per square mile of agricultural land.

The population density is 23 per square mile and if only agricultural land is considered, 25 per square mile. There are 7,670 natives to one European.

TERRITORY OF THE NIGER

The Territory of the Niger, an area of 463,000 square miles, lies north of Nigeria and is bounded on the north by Algeria and Tripolitania (Figure 216). It lies almost in the center of North Africa.

A strip of 48,000 square miles along the southern boundary is acacia–tall grass savanna, valuable grazing land and suitable for the production of warm-weather crops which have some ability to endure drought. Acacia–desert grass savanna forms a belt about 100 miles wide and 81,000 square miles in area, which is grazing land of low carrying capacity and unsuited to crop production.

Desert shrub–desert grass, grazing land of very low carrying capacity, covers an area of 282,000 square miles in the northern part of the Territory. Desert of the extreme type covers about 49,000 square miles. About 1,000 square miles of sub-irrigated oases and 2,000 square miles of marsh grass complete the area.

Land Use.—There are no forests but the scattered tree growth of the savanna

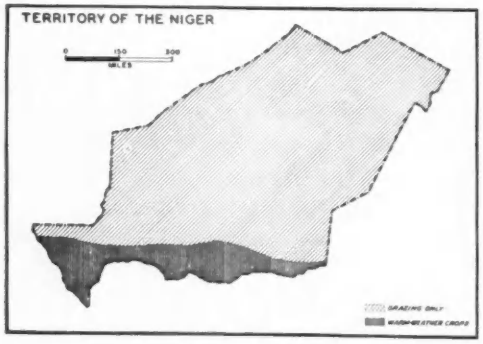

FIGURE 216.—The territory of the Niger has an area of a little over 463,000 square miles. About 49,000 square miles are suitable for warm-weather crops and 414,000 square miles are suitable for grazing only.

is valuable as wood and timber and productive of gum arabic, shea butter, and rubber.

Grazing land of high carrying capacity occupies an area of 49,000 square miles, about 11 per cent of the total area. Grazing land of low carrying capacity covers an area of 363,000 square miles, 78 per cent of the area. The combined area is 412,000 square miles, 89 per cent of the colony. Here cattle, sheep, goats, donkeys, horses, and camels are produced. The total, measured in animal units, amounts to 1,604,000 or 3.9 units per square mile of grazing land.

Land Classification.—Land suitable for the production of warm-weather crops occupies an area of 49,000 square miles, about 11 per cent of the total area. Here are produced millet (probably grain sorghum), beans, groundnuts, manioc, cotton, maize, sweet potatoes, and rice.

Land suitable for grazing only, occupies 414,000 square miles, 89 per cent of the area. About 49,000 square miles of this is desert, practically useless for grazing and probably much of the other area cannot be used because of the lack of surface water.

The principal agricultural exports are cattle, sheep, groundnuts, millet, skins, hides, and donkeys. These amount to about $23.00 per square mile of land suitable for crop production. Much of the export is produced on grazing lands.

The population density is 2.6 per square mile, or if only agricultural land is considered, 25 per square mile. There are 469 natives to one European.

TRIPOLITANIA AND CYRENAICA

This area of 633,000 square miles lies between Tunis and Egypt and is bounded on the south by the Niger colony and the Anglo-Egyptian Sudan (Figure 217). Along the coast there is a small area of temperate brush of about 6,000 square miles and an area of dwarf palm–temperate grass of 4,000 square miles which is capable of producing crops without irrigation.

In the desert area, irrigated or sub-irrigated oases cover about 17,000 square miles. These are most productive areas.

Acacia–desert grass savanna on the better drainage channels probably covers about 4,000 square miles of grazing land. Grazing land of very low carrying capacity, often useless because of the lack of drinking water for livestock, covers most of the area, or 506,000 square miles.

Extreme desert covers 96,000 square miles, mostly in the eastern part.

Land Use.—There are no forests, but woodlands, if one includes the temperate brush and the oases, amount to 23,000 square miles, about 4 per cent of the area. These produce some wood and small timbers.

Grazing land of high carrying capacity amounts to 21,000 square miles, 3 per cent of the area. Grazing land of low carrying capacity covers about 516,000 square miles, 82 per cent of the area. Combined, this amounts to 537,000 square miles or 85 per cent of the area. Most of this land cannot be used, however, because of the lack of water for

the livestock. Here are produced sheep, goats, camels, donkeys, cattle, horses, mules, and a few pigs. The total production amounts to 464,000 animal units or 0.86 per square mile of grazing land. This figure has little significance, however, since if it were based on non-desert land the value would be about 22 animal units per square mile.

Land Classification.—Cool-weather crop land, chiefly valuable for cereals, covers about 10,000 square miles, and warm-weather crop land covers 17,000 square miles. Together the 27,000 square miles is about 4 per cent of the area. Here are produced barley, wheat, table grapes, olives, dates, citrus, figs, and many other products of the oases.

Land incapable of crop production and suitable only for grazing amounts to 606,000 square miles, 96 per cent of the total area. Much of this is non-productive of forage and much of the area which does produce forage cannot be grazed because of lack of water for livestock.

The principal agricultural exports are skins, dates, sheep, goats, henna, alfa (esparto), and native butter. They amount to about $30.00 per square mile of agricultural land.

The population density is 1.2 per square mile, or if only land capable of crop production is considered, is 28 per square mile. There are 22 natives to one European.

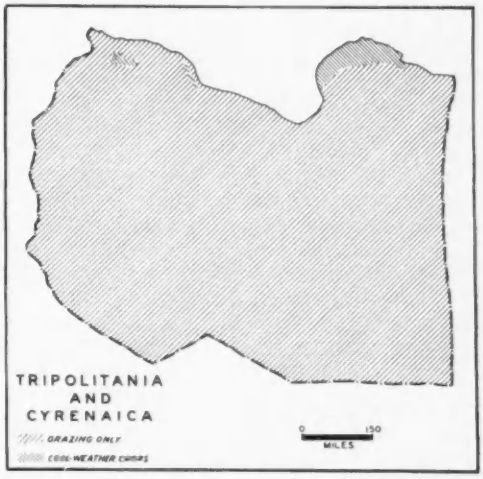

FIGURE 217.—Tripolitania and Cyrenaica have an area of 633,000 square miles. About 10,000 square miles are suitable for cool-weather crops, 17,000 square miles are suitable for warm-weather crops, and 606,000 square miles are suitable for grazing only.

STRATEGIC METALLIC ALLOYS AND UNITED STATES DEPENDENCE

Merle Prunty, Jr.

ECONOMIC self-sufficiency has engrossed the attention of Americans for a decade or more. That recognition of self-sufficiency problems has become increasingly widespread has been evinced by numerous publications, by plans and legislation designed to correct any deficiencies in American supplies. Stock-piling for accumulation of reserves of deficiency materials, encouragement of domestic developments, and abatement of exports of essential materials have been principal objectives of nearly all plans and legislation suggested.

Of the books, monographs, reports, and articles treating the general subject of raw material deficiencies, none had approached the subject so geographically as did Hall in an article in the *Geographical Review* in 1940. Prior to Hall's treatment, matters of policy regulation, substitutes, stock-piles, individual commodity problems, domestic production, and sources had been discussed, but his article integrated them into one major problem.

Dr. Hall was concerned with the " . . . regional character of American dependence on vital deficiency materials." He attempted, using the "strategic" list of seventeen materials so classified by the Army and Navy Munitions Board, to determine the "character and . . . importance of our dependence for these materials on the producing regions of the world." To analyze United States' dependence, he used "transport stowage" requirements expressed in percentages, necessary for annual shipment of commodities involved into the United States. Though Hall's method is not wholly satisfactory, the significance of the resultant analysis should not be under estimated.

The strategic metallic alloys are: first priority, antimony, tin, nickel, manganese, chromium; second priority, mercury, tungsten; third priority, aluminum. Platinum has been included in this discussion, although now classed as critical. This metal was on the strategic list until 1936, and during the period 1934–1938 less than 25 per cent of United States consumption of platinum was derived from domestic sources. Throughout the discussion, averages of the period 1934–1938 have been used, for it is believed that this is the most normal period the world over in the last decade.

Of the seventeen strategic materials, the metallic alloy minerals are perhaps the most crucial element of American deficiency. While alternative uses of minerals, and secondary recovery, offer some freedom from dependence upon original sources, substitutes cannot be produced by methods similar to those employed in the case of the strategic organic materials. Old antimony, derived from the treatment of scrap, is recovered in the United States in quantities comparable to imports of new antimony. While secondary recovery is important in a few instances, it is of no great significance in satisfaction of United States consumption; notably is this true of tin. Nor do the metallic alloy minerals lend themselves to rapid accumulation of comparatively large reserves, as do the non-metallic strategic

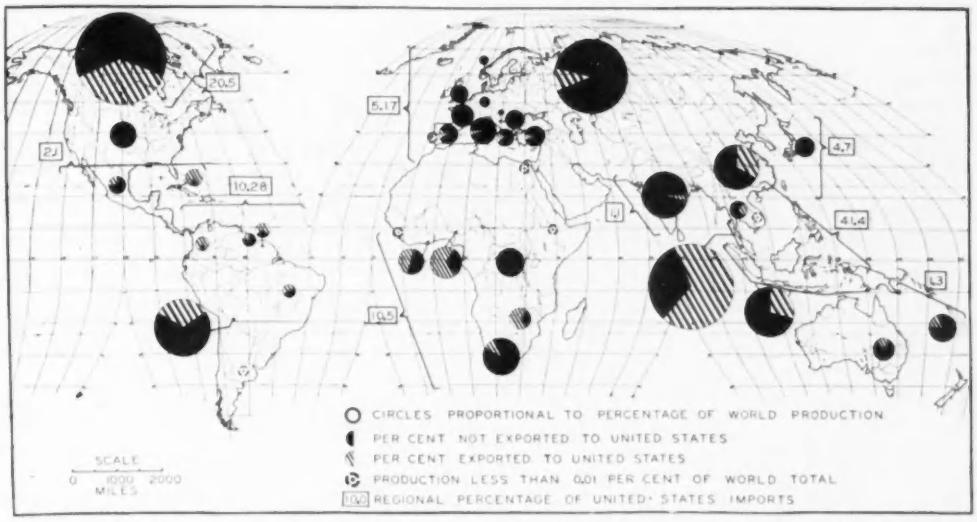

FIGURE 1.—Distribution of producing areas and United States sources of supply of strategic metallic alloys, 1934–1938, by value.

minerals, mica and quartz crystal. Strategic metallic alloys are the products of no special environmental complex which can be duplicated near our boundaries, hence their distribution as now constituted is of vital significance to the United States.

This discussion is concerned not only with regional character of American dependence for vital metallic alloys, but also upon alternative sources of dependence from the world production. The problem is threefold: (1) where, and in what proportion, are the strategic alloys produced; (2) where, and in what proportion, are the United States normal sources of supply, and (3) where, and how trustworthy, are the alternative sources of supply.

No consideration has been included herein to "transport stowage" requirements of the strategic metallic alloys, since it is assumed that this nation can arrange transport when necessary. Use of "transport stowage" requirements for determination of the regional dependence of the United States involves the presentation of an average, expressed as a percentage, which represents, in the case of the strategic metallic alloys, a range greater than that represented by an average of weighted prices. Therefore value has been used herein by assigning each commodity an average of its New York prices over the period 1934–1938, after which process the assigned value was weighted on the basis of quantity. Prices were based upon the metals in their most common form following extraction, or equivalents. For example, 60 per cent tungsten concentrates were used throughout as the base tungsten unit, and other tungsten concentrate ratios were reduced to this unit. Since each commodity is classed as "strategic," it cannot be assumed that one is more important than another. Therefore the application of a price-quantity ratio for one commodity to that of the group in some measure eliminates the striking emphasis placed upon certain commodities which are high in transport stowage requirements, but which cannot, therefore, be classed as more strategic than those whose weight and measure unit is much smaller. Discrepancies between commodities of high- and low-unit value also are considerably modified.

Following weighting of assigned values, the values were totaled by political areas and reduced to percentages of world production and of United States imports. Secondary production and reëxport have been eliminated in each instance.

Dependence of the United States upon foreign sources for strategic metallic alloys immediately becomes obvious. The United States is the greatest market for such commodities, for it consumes about 35 per cent of the world production but produces only 1.6 per cent of the world total, or about 4.7 per cent of its consumption, by weighted values.

The United States produces no tin, though recently discovered ore bodies in southern Idaho may produce in considerable amounts if present world price levels are maintained (New York *Times*, March 31, 1941). About 85 long tons of tin are imported annually from Alaska. Of the 35,220 short tons of nickel consumed annually, the United States averages a production of but 192 metric tons. Eight hundred fifty-seven long tons average annual production of chromite in the United States represents but a small fraction of the average consumption of 337,000 long tons. Substantially the same situation holds for antimony and manganese. The United States produces about one-fourth of its consumption of tungsten and platinum. There is also a substantial primary platinum production in Alaska, which has reached a high of 30,000 ounces annually. Only in production of bauxite and mercury does the United States account for more than 50 per cent of its consumption (Table I).

The following regions were determined by the distribution of producing areas, probability of maintenance of trade routes, and probabilities of political control. The regions are:

I. Canada
II. Caribbean America
III. South America (including the Guianas)
IV. Europe and U.S.S.R. (including Mediterranean Europe and Turkey)
V. Africa
VI. India and Burma
VII. Japan and China
VIII. Southeast Asia
IX. Southwest Pacific (New Caledonia and Australia)

CANADA

Canada supplies United States with 20.5 per cent of the latter's imports of

TABLE I

AVERAGE PRODUCTION AND CONSUMPTION OF STRATEGIC METALLIC ALLOYS IN UNITED STATES, 1934–1938

Alloys	*Consumption*	*Production*
Aluminum (bauxite)	508,706 long tons	341,705 long tons
Antimony	10,068 short tons	668 short tons
Chromium (chromite)	337,181 long tons	857 long tons
Manganese	768,969 long tons	30,680 long tons
Mercury	2,148,975 pounds	1,277,104 pounds
Nickel	35,220 short tons	192 metric tons[1]
Platinum	99,233 troy ounces	23,472 troy ounces
Tin Ore	61,122 long tons	[2]
Tungsten (concentrates)	8,374 short tons	2,720 short tons

[1] Domestic production is a by-product of copper refining.
[2] About 85 long tons produced annually in Alaska.
Compiled from:
The Minerals Yearbook, 1939
Foreign Commerce Yearbook, 1939

strategic metallic alloys (by weighted values). (Figures in the ensuing discussion, other than those of quantity production, have been determined by weighted values.) Ninety-seven per cent of nickel, used in United States, roughly 35,000 tons annually, is shipped from Ontario mines, chiefly from the Sudbury district. Roughly one-third of Canada's nickel production is shipped to the United States. Canadian nickel accounts for better than 95 per cent of the national imports from that area. The balance includes about 22,000 troy ounces of platinum, of which Canada supplies about 31 per cent of United States imports, and about 1,500 tons of chromite, which represents nearly all Canadian production of this commodity.

CARIBBEAN AMERICA

Cuba supplies the United States with 1.6 per cent (by weighted values) of its total strategic metallic alloy imports. This includes nearly all Cuban manganese production of about 81,000 long tons annually, which supplies about one-ninth of American consumption, and about 70 per cent of Cuban chromite production (61,000 metric tons) which satisfies 12.7 per cent of United States consumption.

Mexico supplied the United States with about seven per cent of its consumption of mercury, and during 1934–1936 she supplied more than 50 per cent of its consumption of antimony. The Mexican production of United States consumption dropped sharply in 1937–1938 when China suddenly reëntered the world markets. Prior to 1934, China and Bolivia supplied more than 70 per cent of United States imports of antimony. Of the United States consumption of the strategic metallic alloys, Mexico supplies about one per cent, by weight values.

SOUTH AMERICA

Suranim and British Guiana together account for practically the total import trade (more than 95 per cent) of the United States in bauxite. Suranim ships 68 per cent of her production of this commodity to the United States, which accounts for roughly one-third of the domestic consumption. British Guiana exports about 20.4 per cent of its bauxite production to the United States, but this amount represents but one-thirtieth of the American consumption. Possibilities for expansion of bauxite production in British Guiana are considerable.

Colombian production of strategic metallic alloys is confined to platinum. Eighty-eight and five-tenths per cent of the Colombian production is shipped annually to the United States, and this trade supplies about one-third of the United States imports. Argentina's only contribution is an insignificant amount of tungsten.

Brazil exports 53 per cent of her manganese production to the United States, which provides for 9.9 per cent of the latter's imports of that metal. Bolivia, however, supplies the United States with 7.3 per cent of her total strategic metallic alloy imports—nearly 32 per cent of Bolivian production in these commodities. The United States receives more than one-fourth of the Bolivian tin output, an insignificant amount of tungsten, and about one-sixth of Bolivian antimony production. Bolivia, the highest-cost tin producer, frequently has been mentioned as a reserve source of tin for the United States in case of national emergency. Her production, 1934–1938, averaged 22,506 long tons annually, less than one-sixth of the world total, and about one-third of the United States annual average consumption of this metal.

Limited by transportational difficulties, labor conditions, and plant capacities, it is improbable that Bolivia could approach satisfaction of American needs upon two years' notice.

As a region, South America supplies 10.28 per cent of United States imports of the strategic metallic alloys. Bolivian dominance in this trade is evident. The western hemisphere, as a region, supplies the United States with but 32.88 per cent of her imports of these commodities—less than the exports to this country of British Malaya.

EUROPE AND U.S.S.R.

But 5.17 per cent of United States imports of the strategic metallic alloys originate in Europe and the U.S.S.R. Russia is responsible for 3.8 per cent of the total imports, or more than one-half of the amount shipped from this entire region. About one-eleventh of the Russian manganese output is exported to the United States. Of this commodity, the U.S.S.R. furnished slightly more than one-half of the world production. This trade accounts for about one-third of the United States consumption of manganese. The U.S.S.R. also exports platinum and chromite to the United States in considerable amounts, and small amounts of mercury.

Occasionally small shipments of aluminum are supplied to the United States by France, Norway, or Yugoslavia (usually in the form of bauxite). This is not, however, an actual dependency trade. Shipments from Norway are reëxports following processing. This aluminum trade all but disappears when considered on an average basis over a period of years.

The United States receives insignificant amounts of tungsten from the United Kingdom, but, aside from the U.S.S.R., the balance of the United States trade with the region in commodities under consideration is centered in the Mediterranean region.

Spain and Italy together supply the United States with about 87 per cent of her imports of mercury. Italy furnishes 33.9 per cent and Spain 53 per cent of the United States imports of this commodity. Normally, the United States receives none of the Italian bauxite output and antimony production, neither of which is large.

Turkey, one of the four leading producers of chromium (others are U.S.S.R., Southern Rhodesia, South Africa), exports about 9.8 per cent of its output to the United States. This trade furnishes the United States with 4.7 per cent of its imports of chromite. Greece exports about two-thirds of her average production (40,110 metric tons) of chromite to the United States, which accounts for 8.5 per cent of the latter's imports of that commodity, and 22.8 per cent of the Greek strategic metallic alloy output. Nickel and bauxite also are produced in Greece, but are not exported to the United States in significant amounts. The United States normally does not share in the Hungarian and German strategic alloy production.

AFRICA

Africa, as a region, supplies the United States with 10.5 per cent of its strategic alloy imports. Four areas, the Gold Coast, Nigeria, Southern Rhodesia, and South Africa, supply nearly all from the continent. The Gold Coast ranks fourth in the world production of manganese, and second as an American source of supply, furnishing about one-fourth of United States imports of this commodity. Forty-seven per cent of the manganese production of the Gold Coast is exported to the United States. Nigeria ranks sixth

in the world production of tin, and supplies nine per cent of the United States imports of this commodity.

Southern Rhodesia exports 72.2 per cent of its chromium (chromite) production (164,000 metric tons, average) to the United States annually. Together with South Africa, this area furnishes better than 40 per cent of United States chromite imports. South Africa exports about 10 per cent of its production of strategic metallic alloys to the United States. About seven-tenths of this trade is in chromite (production, 135,000 metric tons, average), and about three-tenths is in platinum (production, 42,000 troy ounces, average), by weighted values. Manganese and tungsten also are shipped to the United States, but in insignificant amounts.

India and Burma

India and Burma together rank eighth in world chromite production (44,000 metric tons, average), second in manganese output (772,000 long tons average), second in tungsten production (4,627 metric tons, average, of 60 per cent concentrates, or equivalent), eighth in tin production (4,220 long tons, average), and fourth in nickel output (1,237 metric tons, average).

Of this production, the United States receives 7.8 per cent, in which chromite and manganese only are represented. About nine per cent of United States manganese imports and five per cent of United States chromite imports originate in the India-Burma area. One and one-tenth per cent of the United States total imports originate in this region.

Japan and China

China supplies 4.7 per cent of the United States imports of strategic metallic alloys. Thirty-three and three-tenths per cent of the Chinese production is exported to the United States. Tin, of which China is the fifth largest producer (10,000 long tons, average), and antimony, of which China also is, normally, the largest producer (14,000 metric tons, average), and a considerable amount of tungsten, of which China is the leading producer, comprise all of China's exports to the United States. China supplies about 5.1 per cent of the United States tin imports. Japan, which produces chromium, tin, and small amounts of platinum and tungsten, does not export any of these commodities to the United States.

Southeast Asia

British Malaya, Netherlands Indies, Siam, and French Indo-China furnish, together, 41.4 per cent of the United States imports of strategic metallic alloys, by weighted values. About one-fourth of the Siamese tin production (12,500 long tons, average), about 27 per cent of the Netherlands Indies tin output (26,000 long tons, average), and about 71 per cent of the British Malayan tin production (53,000 long tons, average), are exported to the United States. In addition to the tin production of this region, which dominates the strategic alloy picture, British Malaya exports large amounts of tungsten, as do also Siam and the Netherlands Indies, but in small quantities, and the Netherlands Indies produce considerable bauxite (166,000 long tons, average), very little of which is shipped to the United States. The Philippine Islands are in the process of developing a chromium industry which may become of major importance. In 1940, the Philippines exported monthly an average of about 2,250 tons of manganese ore, 35 per cent metal content, to the United States,

which represented the first substantial productions of the developing manganese industry. The exports of Philippine chromium to the United States reached 64,938 tons during 1940, an increase of about 26,000 tons above the exports to this nation during 1938. War in waters adjacent to the Philippines would seriously jeopard shipments to the United States. This region furnishes the United States with about 80 per cent of its tin imports.

SOUTHWEST PACIFIC

New Caledonia long has been noted for its nickel and chromium mines. Actually, New Caledonia ranks sixth in world chromium production (51,500 metric tons, average), and second in nickel production, though the Canadian output of this metal is more than twelve times that of New Caledonia. A very small amount of the New Caledonian nickel is exported to the United States, but nearly all the chromium production is shipped there. About 15 per cent of United States chromite imports originate in New Caledonia, and this represents more than 98 per cent of the latter's production. Sixteen and eight-tenths per cent of the strategic alloy output of New Caledonia is exported to the United States.

Australia is a small producer of antimony, platinum, and tungsten, none of which, except about 45 per cent of the tungsten output, reaches the United States. Australia ranks ninth in world production of tin (3,200 long tons, average), and of this amount about one-sixth is shipped to the United States. Eighteen and five-tenths per cent of the strategic metallic alloy production of Australia is exported to the United States. This region supplies 1.3 per cent of the United States imports of these commodities.

ALTERNATE SOURCES OF SUPPLY

Assuming that United States, since the acquisition of rights for construction of military bases on several British possessions in the Caribbean area, British Guiana, and Newfoundland, is able to maintain her supply lines, in case of emergency, to Canada, the Caribbean, western South America, and along the east coast of South America at least as far as Bahia, Brazil, where can the nation find alternative sources of supply for the strategic metallic alloys if any one of the other major regions upon which she is dependent no longer is open to her trade?

An ample supply of nickel, sufficient to meet any contingency, exists in Canadian production. It is reasonable to assume that this supply will be available to United States under any circumstance now conceivable. Maintenance of trade routes as far south as Bahia would ensure United States of bauxite from Suranim and British Guiana which is necessary to meet the national deficiency in that commodity. Prior to 1937, Mexico and Bolivia, together, were supplying more than 50 per cent of the national deficiency in antimony. Since their combined average production is greater than the consumption of United States, it is reasonable to assume that a dependable source of supply for antimony exists in the western hemisphere in the event of complete stoppage of the Chinese exports.

If Chinese exports of tungsten should be stopped, within the hemisphere (excluding Argentina) the United States could find sufficient normal production to meet, along with the normal national production, about half the normal domestic consumption. Three alternate regions then would be available: Southeast Asia, India and Burma, and Portugual-Spain. Production of South-

east Asia, if available *in toto*, would meet the normal consumption of United States when added to the previously mentioned productions. If this region should not be open to United States, it is probable that the India-Burma region also would not be available as a source of supply. The remaining areas of production would not then be sufficient to meet domestic consumption.

If the Mediterranean region should be closed to United States trade, Mexican mercury production would be sufficient to provide slightly more than 50 per cent of the national deficiency in that commodity. Of the remaining 48+ per cent, China and U.S.S.R. could furnish nearly, but not quite, all, provided their total mercury production were exported to United States. It is reasonably safe to assume that under no circumstances would this occur, especially as regards U.S.S.R.

Slightly more than 13 per cent of United States deficiency in chromium can be met in the western hemisphere by Canada and Cuba. In this instance the maintenance of trade routes with South Africa and Southern Rhodesia would be vital, for these areas supply about 45 per cent of the national chromium imports. Turkey, Yugoslavia, and New Caledonia offer alternate sources, sufficient, together, to meet the national deficiency, provided the total production of each area is exported to United States.

Platinum production of Canada alone is sufficient to meet domestic requirements of United States. Colombian production, in addition, is sufficient to meet at least 40 per cent of the national deficiency in this metal.

If, in case of emergency, United States could maintain trade routes to Brazil, and could import the total Brazilian and Cuban manganese production, the western hemisphere could supply United States with about 248,000 long tons of that metal annually. Normal total United States consumption is roughly three times that amount, therefore a two-thirds deficiency still would exist. The U.S.S.R. could meet this deficiency. Were the production of that nation not available, the output of the Gold Coast and of South Africa, together, could meet the national deficiency. The India-Burma production is more than sufficient to meet the needs of United States in this metal, but it is doubtful whether the Indian production would be available to United States if that of South Africa, and especially of the Gold Coast, were not.

In the western hemisphere, only Bolivia produces tin in quantity. Bolivian tin production averages about one-third the national consumption of this metal. Assuming production of China and Southeast Asia no longer available to United States, sources of tin available would include (beside Bolivia), Nigeria, the Belgian Congo (with whom no trade in tin exists, at present) and India-Burma. Total average production of these areas is but 18,300 long tons. Assuming that the Southeast Asian tin production only were removed from imports of United States, this nation would be exceedingly hard pressed to accommodate the resultant deficiency. Upon the Southeast Asian area United States is utterly dependent for at least some of her tin imports.

SUMMARY

The United States, richly endowed with numerous varieties and great deposits of mineral resources, is singularly lacking in quantities of the strategic metallic alloys. Few political areas, however, are correspondingly fortunate in that they possess workable deposits, however small, of such a variety of these

alloys. Nonetheless, the United States, the greatest consumer of these commodities, depends upon foreign sources in nearly every quarter of the globe for more than 95 per cent of the materials which she uses.

Since the world distribution of areas in which the production of the strategic metallic alloys is feasible involves neither reason nor regularity, and since supernationalism now appears to be rampant upon the earth, the uneven character of the world producing regions, both as to location and to product, is of marked importance to this nation.

Within the hemisphere it is possible for United States to obtain her normal supplies of nickel, bauxite, antimony, and platinum. For tungsten, mercury, chromium, manganese, and tin, United States must depend to a considerable degree, at least, upon areas outside the western hemisphere. Especially must United States depend upon Africa, China, Southeast Asia, and the Southwest Pacific for some of each of these materials. In the words of Dr. Hall, our dependence is "so vital and complete that our very existence as a great industrial power, and perhaps even as an independent state, is threatened if the source should be cut off."

WATER AND NORTHWEST MISSOURI

Carol Y. Mason

NORTHWEST Missouri is suffering from a peculiar kind of drought. It is not at all evident in the verdant spring landscape, where green fields of wheat, alfalfa, bluegrass, and oats are punctuated by squares of black earth with lines of green young corn. Most of the dead trees resulting from the drought of 1936 have disappeared, and even in the autumn crops seem in good condition. Yet beneath the immediate surface soil the supply of moisture is subnormal, and has been so for a long time.

That the rains have failed to come in sufficient quantities for more than ten years in areas as far east as Missouri is not realized in other parts of the country, where people sometimes speak of the "drought of 1930" or the "drought of 1934" as isolated occurrences. The continued dryness has resulted in a lowering of the water table which has had a profound effect upon many phases of life in the northwestern part of the state. At the time of this writing, in May 1941, there have been moderate spring rains, but not what the farmers call abundant ones. Soil on the hilltops is moist to a depth of two or three feet, but below that the earth is dry. Hilltop wells 60 feet deep, which ten or fifteen years ago produced abundant water, today yield very little. Some which went dry in the drought in 1936 are still dry, as surface rains have not been sufficient to moisten the entire layer of earth and replenish them.

The northwestern part of the state of Missouri, a somewhat dissected area of partially loess-covered Kansan glacial drift in the southwestern part of the Corn Belt, is an agricultural region of rich soil, large farms, and small towns. The original vegetation was prairie grass, with forest in moister areas along the valleys. The soil in early days was black and deep with the water table high enough in spring to make tile drainage desirable on many farms. Springs were numerous and shallow wells on the upland furnished abundant water. Roads were "bottomless" for weeks in spring when melting snows and heavy showers made a sticky mudhole of everything not covered with vegetation, and it was impossible to travel.

Today it is still impossible to work in the heavy, sticky mud of the fields after a rain, and dirt roads are made impassable by wet weather. But wind

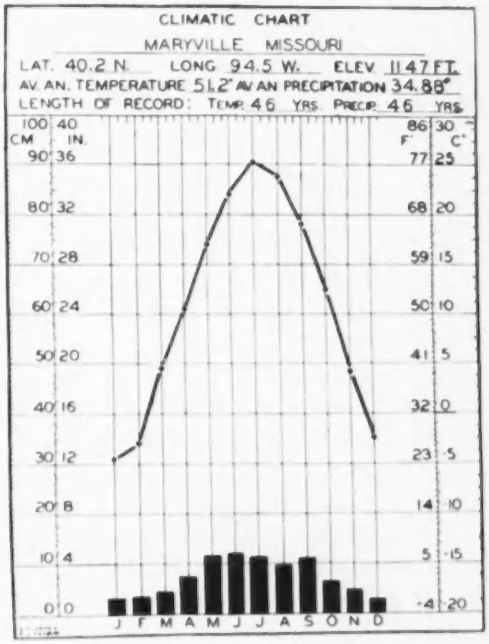
CLIMATIC CHART
MARYVILLE MISSOURI
LAT. 40.2 N. LONG 94.5 W. ELEV 1147 FT.
AV. AN. TEMPERATURE 51.2° AV. AN. PRECIPITATION 34.88"
LENGTH OF RECORD: TEMP. 46 YRS. PRECIP. 46 YRS.
CM
IN.
F°
C°
J F M A M J J A S O N D

FIGURE 1.—The chart is typical of the region of which Northwest Missouri is a part, definitely continental.

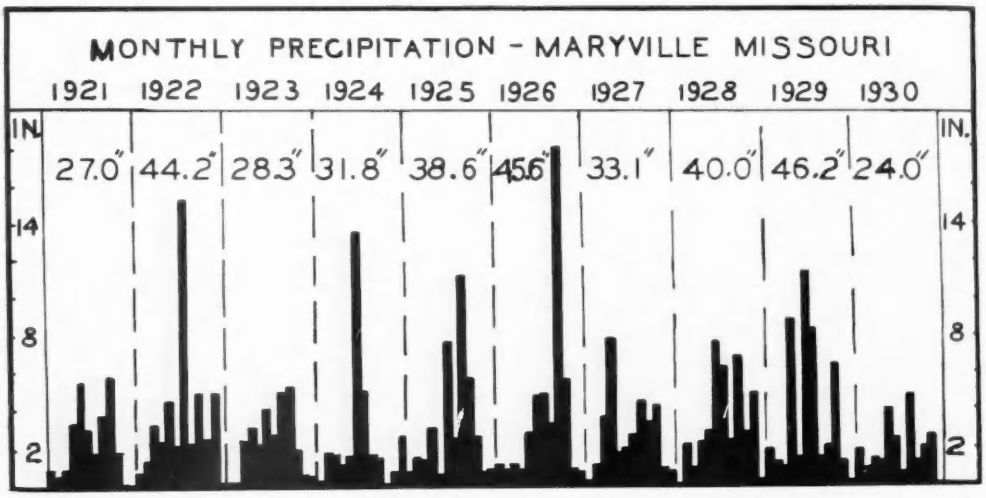

FIGURE 2.—The variation of precipitation from month to month is a conspicuous feature of the record for the decade.

and sun soon dry the surface, and the added moisture does not have a chance to penetrate more than a few inches or at most two or three feet, while the permanent water table many feet below is still receding. Wells have gone dry on hundreds of farms, and the effort to find new sources of well water is not always successful. Farmers and even towns have had to haul water many miles, and some are still doing it. There is no water bearing sandstone under Northwest Missouri from which drinkable water can be obtained, and the depletion of surface supplies is a critical matter. In areas like parts of the Dakotas, where deep artesian water is available, lack of rain is most critical in connection with the crops, but in Northwest Missouri it affects not only the crops but the entire water supply problem. Rain at the proper time of year may make possible good crop yields, but only a series of unusually rainy years will restore the ground water once it has been as seriously depleted as in this region. That the wet years of a rainfall cycle will come, no one doubts, but in the meantime the area has temporarily taken on some of the characteristics of dry lands farther west.

Maryville, Missouri, a representative station for the northwestern part of the state, has had a 46-year average of 34.88 inches of annual precipitation. The maximum, as characteristic of a continental climate, comes in early summer, but there is a tendency toward a secondary maximum in early autumn, as shown in Figure 1. The excessive rain of September, 1926 (Figure 2) causes this to appear greater than it would if the record were for a longer time. Northwest Missouri is too far west to receive benefit from many tropical air masses which bring abundant rain to the eastern part of the state. Lows from the northwest often pass to the north, while lows from the south often pass to the east, and the streams of warm moist air drawn into them do not extend far westward. The result is that although cloudiness may be present there is little precipitation. In the spring and fall, however, lows are more likely to cross the area, and there is considerable frontal activity, frequently with brief but very heavy rain.

The erratic nature of the precipita-

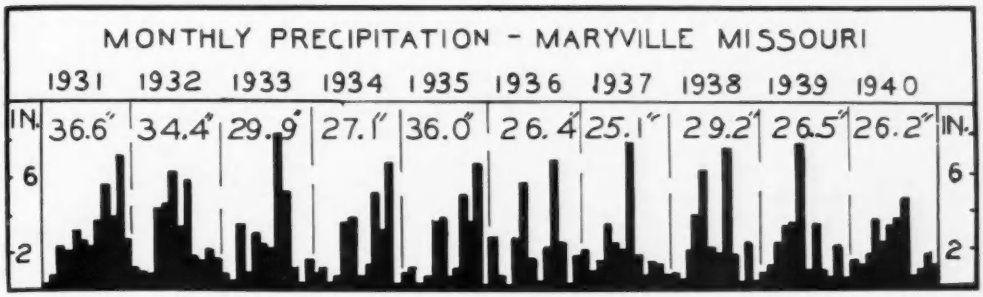

FIGURE 3.—Variability for the period of this decade is not so high as for the earlier decade of Figure 2.

tion of Maryville is well brought out by Figures 2 and 3. Rarely does the maximum rain occur in the same month on two successive years, and it may occur in any month from April to November. September, 1926 had more than 20 inches of rain, while September, 1937 had less than an inch. For the crops this distribution is more important than quantity alone, but for the entire water supply of the district, quantity is of great importance.

When summers are hot the effectiveness of precipitation is greatly reduced, a factor which has been very significant in the last ten years. The 46-year average monthly temperatures are in every case higher than the 40-year averages made six years ago. In 1934 the average temperature for June was 80.3 degrees, for July 85.1, and for August 79.9 degrees F., while the 46-year averages for those months are 71.7, 77.1 and 75.1 degrees F. In July, 1936 there were 22 days when the temperature rose above 100 degrees and 16 nights when the minimum was above 70 degrees F. The summers of 1934 and 1936 will long be remembered in Maryville for their searing hot dry southwest winds. These were not only years of very low rainfall but years of very high evaporation.

Figure 4 shows the annual precipitation of Maryville for 46 years. The last decade shows notably subnormal rainfall, by far the longest of any period of deficiency since the record began. The dotted line indicates the 46-year average, while the 40-year average taken through 1934 is about two inches greater. On the basis of the earlier average, Maryville has had 11 successive years with a deficiency of moisture. The record of Leavenworth, Kansas, which is the longest for any station in the same general region, shows an annual precipitation nearly the same as that of Maryville, and the years in which the two records overlap show considerable agreement as to succession of wet and dry years. The Leavenworth record, which goes back to 1836, shows at first a period of nearly 30 years in which dry years predominated, followed by another similar period dominated by wet years. If the early part of the Maryville record shows a continuation of this wet cycle, as it appears to do, it may be that the dry cycle of the present time is near its end.

Many examples of the dwindling water supplies may be cited. There are 4,000 farms in Nodaway County alone, and many of the farmers have had to haul water for their stock in recent years. Some of them have been doing it continuously, winter and summer, for several years. At the city water plant of Maryville an increase in the number of farmers coming to buy water was noted in 1938, and has continued ever

since. They drive in from farms as much as fifteen miles away, pay fifty cents a thousand gallons, and take the water home in barrels, tanks, and other containers.

Many farmers who have been unable to undertake the arduous task of hauling the water have sold their cattle and hogs in the autumn because of insufficient water to take them through the winter. Years ago Northwest Missouri was a land of almost continuous corn and tremendous herds of beef cattle. Many factors have contributed toward a change in that situation, some of them being the advisability of rotating crops in an area where depletion of soil fertility is serious, low prices during the depression, crop failures during the long succession of dry years. Rarely are large herds seen in the region today, although recent good corn crops have encouraged the farmers to buy stock again, and Herefords and Aberdeen Angus are again to some extent dotting the hillsides. The growth in number and size of the herds is directly limited by the scarcity of water, and corn crops alone will not make it possible for the area to regain its importance in cattle raising.

The physiographic nature of the region is important to an understanding of ground water conditions. Pre-glacial valleys on Pennsylvanian rock were completely covered with Kansan drift, which in turn was partly blanketed with loess from the Missouri River eastward to some distance east of Maryville. In most of the region there is no visible evidence of glaciation except in obscure places where erosion has uncovered the

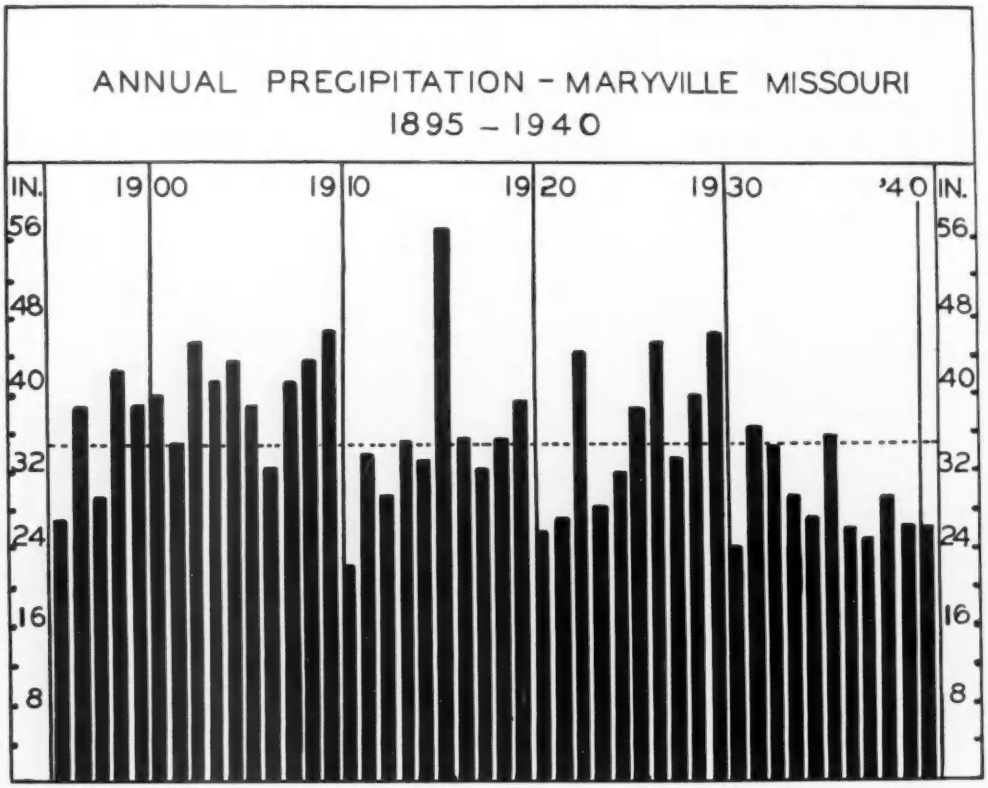

FIGURE 4.—The variability of moisture supply from year to year partially explains the hazard that accrues to farming in the area.

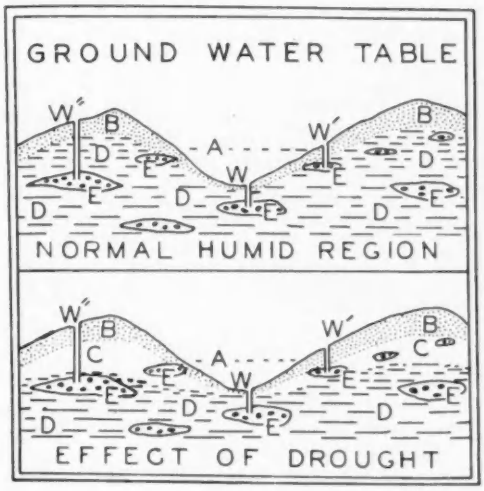

FIGURE 5.—A. Small valley with intermittent stream. B. Zone in which soil is wet after a period of rains. C. Zone which is permanently dry. D. Zone in which soil is permanently saturated with water. E. Scattered lenses of sand and gravel in the glacial drift. The material which yields water for dug and bored wells in Northwest Missouri. W. Well which never goes dry. The location of wells in many pastures. W'. Well which may go dry and remain dry over a period of dry years. Type upon which many farmhouses and some barns depend. W''. Well which never goes dry. May be a bored well 75 feet deep. Expensive partly because of uncertainty of reaching water-yielding gravel, even below the permanent water table. Some farmers have spent large sums on trial wells of this type during the drought, sometimes without success after six or eight holes.

drift. Rock outcrops are rare, and the depth of the overlying mantle is extremely variable because of the irregularity of the rock surface beneath. Much of the soil is Marshall silt loam, a highly flocculated prairie soil developed on the glacial and loessial material. The land is moderately hilly as a result of dissection, a completely well drained upland cut by small valleys everywhere, with southward flowing master streams in broad floodplains.

Farms in Northwest Missouri have always depended upon shallow wells for a considerable part of their water supply. Some wells are dug, but many are bored with a rotary drill, and are 15 inches in diameter. The farmhouse is usually on a hill, and wells 40 feet deep have often been adequate to supply the household needs for many years, until the drought. The depth of the well depends upon two factors: position of the water table, and position of a lens of sand or gravel through which water moves rapidly in the drift. Before the drought it was only a matter of finding the sand which was important in drilling, but today the upper sand lenses dependable for so many years, no longer produce. Out in the pastures the windmills and their watering tanks for the stock are almost invariably in the valleys. Figure 6 shows one well placed where several hollows converge. Such wells, sixty feet or more below the level of the hilltops, are dependable, and most of them contain water throughout the summer, although often in smaller quantity if the summer is dry. The tiny valleys are dry most of the year, but after the rains they concentrate the run-off in the hollows, and the ground water table is apparently replenished as well as being always nearer the surface on account of the topographic relationships. In locations where the farm includes part of one of the major floodplains, stock are driven to the river or to ox-bow lakes for water, while the house is supplied from very shallow wells. In many cases springs occur in the valleys, and the water is piped from them to storage tanks from which it is used for the stock.

With the continuance of the drought, well after well has gone dry on the upland. Some farmers have had ten or fifteen new wells bored on their land in an effort to find water, but without success. Deep wells may produce enough water to supply the house if it is meted out by the cupful, but even in the valleys the wells in many cases now do not produce enough water for more than a few cattle. The irregularity of dis-

FIGURE 6.—Typical farm pasture of Northwest Missouri, with windmill in the hollow, and a herd of Hereford cattle.

tribution of sand and gravel lenses through the drift adds greatly to the difficulty in finding new satisfactory wells. R. M. Trowbridge (unpublished thesis, University of Missouri, 1938) who made 70 well borings in exploring the drift in this part of the state as well as studying the logs of many others, states: "A well 150 feet deep in the drift may penetrate four or five such sand beds, each ranging from two to six feet in thickness. Another well less than a quarter of a mile away from the first may penetrate only one thin sand bed or none." He cites as an example two wells in Nodaway County, only ten feet apart. One penetrated a seven-foot sand bed at 42 feet, the other reached no sand at all until a depth of 135 feet. This unevenness probably results from re-working of till and fluvio-glacial material in brief re-advances of the ice during Kansan time. Because of the impossibility of detecting these sand and gravel beds from the surface, farmers often make many trials before finding a spot in which ground water is moving sufficiently rapidly to furnish a satisfactory supply. If a good well is not to be had near the barn, even abundant water in a pasture well does not satisfy the needs of the farm. Most of the farms, even where there are several hundred acres, are run by one man with machinery and occasional hired help, and sufficient water for a herd of cattle cannot be hauled across the fields all winter. Neither can the cattle be driven to the water during the severe cold weather, for if they get cold on the way they will not drink when they get there.

The major floodplains are the only places in which wells are still entirely dependable, and even there the water table is generally 15 feet below the surface at a little distance from the river. It has not declined to the point where it is below the level of the stream bed, however, and although small these rivers contain some water all summer. One reason for the lowered water table in the floodplains is the straightening of the rivers. Many drainage districts were formed about 30 years ago, rivers straightened, and farmers taxed to pay the cost. The farmers are still paying taxes on these projects, at the same time that they feel the effects of the lowered water table. Figure 7 shows the 102 River in its straightened course where it flows toward the reservoir of the city water plant, just east of Maryville. Old abandoned curves are indicated by lines of trees through the fields at the right of the picture. While the present channel is not sufficient to take care of floods, which was the hope when it was built, it does have a slightly greater gradient than the old. This has allowed the stream to erode its channel somewhat, lowering the outlets of all tribu-

tary streams and allowing them in turn to incise their valleys. Many tiny valleys show a second cycle of erosion, with miniature floodplain terraces and abandoned meander scars.

Because of the lack of formerly dependable ground water supplies for watering the stock, farmers in Northwest Missouri have had more than an ordinary interest in conservation programs which have involved construction of surface ponds. The hilly land is badly eroded in many places, and farmers coöperating with the Soil Conservation Service have had numerous dams constructed across the gullies. Although in many cases these are small (Figure 8) and fill with silt within a year or two, some of them are of good size and make valuable reservoirs from which cattle get water all summer. The State Conservation Commission is also furthering a program for the restoration of wildlife on farms, in which permanent ponds are constructed on watersheds covered with grass or other vegetation where there is little erosion. These likewise conserve valuable water for the stock, as well as holding back some run-off and allowing a greater period for filtration into the soil.

The soil conservation program, with its terracing and contour plowing, is helping with the conservation of water in the surface soil. Figure 9 shows contour plowing and strip cropping on a field about a mile southwest of Maryville. The contrast between the field thus properly cared for and those in which a sprangling gully system is still being allowed to develop, just below it in the picture, is notable. The number of farms in Northwest Missouri in which proper conservation practices are carried out is still small, but increasing. Even where contour plowing is carried out, the drought has been too severe and too long in duration for this to cause moisture to get through to the permanent ground water table. Yet it has greatly improved the condition of the surface soil and increased the crop yields. The immediate value of the practice is illustrated by the experience of a farmer in a near-by region of Iowa in 1940, where conditions are much like those of Northwest Missouri. Two 45-acre plots of similar soil and land form

FIGURE 7.—Straightened 102 River and reservoir of the city water plant, two miles east of Maryville, Missouri. Old meanders of river outlined by trees on the farm land.

FIGURE 8.—Farm ponds in a gully, a common sight in Northwest Missouri. The water supply for cattle on most farms throughout the region is derived from such ponds.

were planted to corn. In one, of rectangular pattern and straight rows, the yield was 45 bushels to the acre, while in the other, plowed on the contour, the yield was 70 bushels to the acre. The difference was attributed to the additional water conserved by contour plowing.

Towns and cities as well as farms have felt the effects of cumulative dryness. Bedford, Iowa, close to the Missouri line, hauled water in tank trucks like the great gasoline transports, for an entire summer before a new dam and lake could be constructed to serve as an emergency supply. Savannah, Missouri, hauled water in gasoline transports from St. Joseph 12 miles away, for four months in the winter of 1939 and 1940, carrying 40,000 gallons a day and selling it at $2.50 a thousand gallons. The present town water supply is a lake with very small drainage area, and would be sufficient for only about half of the town's 2,000 population even in years of normal rainfall. There has been considerable difficulty over the problem of selecting a new source, and no solution has yet been reached. A larger drainage area where a new lake could be built is objected to because of graves in the vicinity. A well on the floodplain of the Missouri River such as those used by Mound City, Oregon, and other towns would furnish abundant water but would necessitate laying miles of new mains as well as the cost of pumping a long distance. The 102 River, a permanent stream which is closer, could be used only after the expense of constructing reservoirs and purification plant. In December, 1940, the citizens for the second time voted against a bond issue for the construction of a well, and will get along by using local wells and water hauled from St. Joseph during emergency shortages, until some decision can be reached, or until the annual rainfall makes a decided increase in the local supply.

The city of Maryville has been more fortunate than some, in the accessibility of the 102 River. There has been a water plant there for more than 50 years, originally a private company, now a plant owned by the city. Yet even in this case there has been danger of serious shortage, and there are many problems created by the character and distribution of precipitation. The water in the river frequently becomes very low in the later part of the summer, but the scarcity is less serious than that in the winter, when it sometimes freezes solid. In either case, two large reservoirs constructed in 1938 and 1939 by dredging on the site of old ones which had nearly silted up, furnish adequate storage capacity. The two hold more than 70,000,000 gallons of water, enough to supply the city of 5,000 people for six months. The lakes, as they are called, are situated at one side of the river (Figure 7), and are filled by pumping from the stream just above a ten-foot dam.

The three great problems connected with rainfall at the Maryville Water Plant are quantity of water, hardness, and suspended matter. In the year 1939 there were only three occasions in the entire 12 months when the river rose

as much as three or four inches. The capacity of the plant for pumping into its reservoirs is four times the pumpage into the city mains, a fact which makes it possible to keep the reservoirs well supplied by pumping only a quarter of the time. Thus it is possible to choose the best time to pump. On September 15, 1939 there was enough water behind the dam so that the reservoir could be replenished, and the stored supply was sufficient to carry safely through the winter with what little could be added when the stream was not frozen solid. Both the lack of precipitation and the duration of freezing weather may determine whether or not there is a shortage of water in the winter.

The best time to pump from the river is not always determined by the quantity of water, but frequently by its quality. The water plant softens the water by removing some of the carbonates, maintaining the city supply at a constant hardness of about 105 parts per million, dissolved mineral content. This is a moderately soft water, while that of the river is frequently very hard. In winter especially, when the river gets more of its underground supplies and less from surface run-off, the alkaline content, which causes the hardness, becomes high, sometimes even as much as 200 p.p.m. Thus it is undesirable to pump at that time if it can be avoided. By selecting good times to pump, when the water is less hard, the load on the water softener of the plant is decreased. On the other hand after a heavy rain when surface run-off is at a maximum and the water is highest and softest, it is very muddy, and pumping must be avoided then also in order to prevent undue silting of the reservoirs. The best time to pump is therefore long enough after a rain to allow for the settling of mud, but not long enough after to permit the hardness to increase much. The water is filtered and

FIGURE 9.—Contour plowing and strip cropping, adjacent to an uncontrolled gully system. Near Maryville, Missouri.

chlorinated, as well as softened, before being pumped into the mains.

While water supply problems created by drought have been solved in some cases, especially in the towns, they are far from being solved for the farmer of Northwest Missouri. The great drought years for this region were 1934 and 1936, especially the latter, when it is estimated that corn yielded only one or two bushels an acre. But even the ten-year average corn yield is estimated at only 26 bushels per acre, a very low figure considering the fact that 40 bushels is not uncommon. Thus crops show the effect of drought, and the last two or three years have benefited by a favorable distribution of rainfall to such an extent that good crops have buoyed the farmer's hopes in spite of low water in the wells. Depression and economic readjustments and drought together caused the loss of many farms, and a great increase in tenancy, with its accompanying bad psychological effect. But in 1940 and 1941 many people started to buy farms again, and there has been a great shift of ownership. Yet low prices and fear of drought and water shortage continue to be the Sword of Damocles hanging over the farmer's head, and cause a defeatist attitude among some. Stabilization of prices will help to give confidence in the immediate future, and with better rainfall conditions the situation has already improved some. But Northwest Missouri still awaits its urgent need, the up-swing into the wet years of the rainfall cycle.

ALTERNATIVE SOURCES OF RUBBER

Joseph A. Russell

RUBBER is one of the first priority strategic materials classified as indispensable to American industry. Yet production of this commodity is centered in one of the distant corners of the world, and the owners of these lands are conquered or are at war. The routes by which rubber arrives in the United States are long and insecure, and the majority of the ships which carry it to America are subject to the hazards of war.

The United States uses about half of all the rubber consumed in the world, and in 1939 more than 95 per cent of the world's supply came from the warm, humid lands of southeastern Asia and its island fringe. This commodity was the largest single raw material imported into the United States between 1934 and 1939, and in the later year was valued at nearly $178,500,000. In 1937 there were 477 establishments using rubber as the major ingredient of their industry, employing 129,601 wage earners who received $170,775,281. The cost of materials used in these establishments was $514,053,971 and the finished products were valued at $882,538,514. There can be little doubt of the significance of this commodity in the American economy, yet the raw material for the rubber industry is produced almost entirely outside the political control of the United States, and in 1938 some 80 per cent of it was carried to these shores in foreign bottoms; 50 per cent British, 20 per cent Dutch, seven per cent Japanese, and three per cent Norwegian.

The major trade routes of rubber have already shifted. In normal times 92.3 per cent of our rubber comes via Suez, .8 per cent by the Panama Canal, and 5.3 per cent across the Pacific to west coast ports. Between 1936 and 1938, 50 to 60 per cent of the rubber destined for the United States came via the Cape of Good Hope, and only 12 per cent by Suez, while 10 per cent was transported across the Pacific to west coast ports, and another 10 per cent through the Panama Canal to south and east coast destinations. Three per cent of our supply came from South American and African ports during this time.

Alternate Sources of Rubber Supply

There is no certainty that the Asiatic supply of rubber will ever be denied to American consumers, or that the price will be unduly inflated, but the possibility is strong enough to warrant an evaluation of alternative supplies. There are four potential sources which would be relatively defensible in the event of an overseas emergency: (1) "synthetic rubber" (elastomers); (2) recovered rubber; (3) natural rubber from latex-producing plants such as guayule, etc., and (4) production from *Hevea* plantations of tropical America, chiefly Brazil. It is the major purpose of this article to report on the 13-year-old attempt of the Ford Motor Company to relieve itself of dependence on the rubber plantations of the Middle East.

1. *Synthetic Rubber.*—Synthetic rubber does not appear to be an immediate solution to the problem of the United States rubber supply. In 1939 less than 4,000 long tons (all tonnage figures in

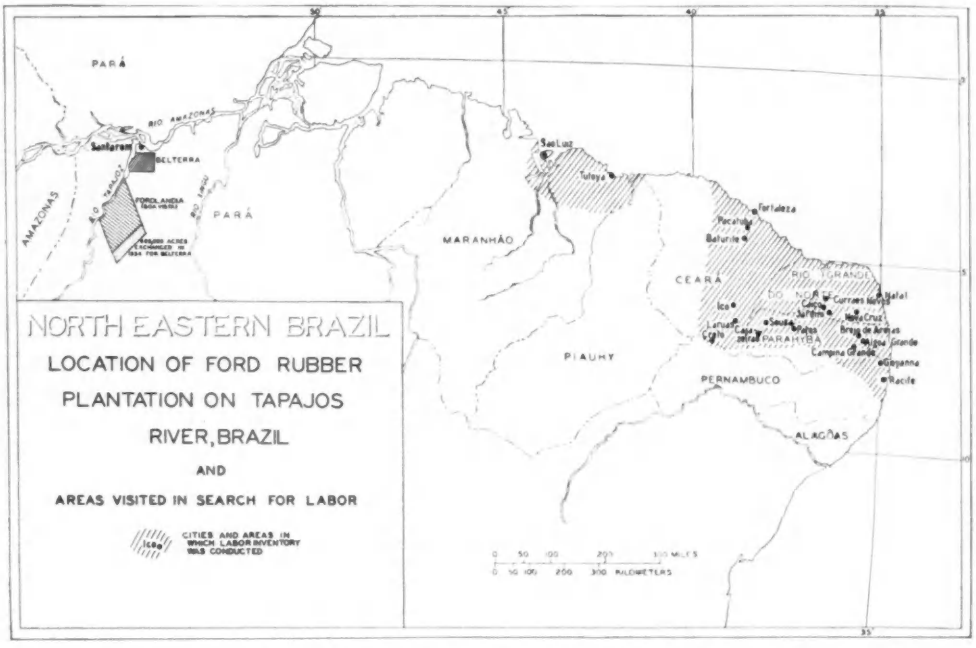

FIGURE 1.—Location of the Ford rubber plantations on the Tapajos River, Brazil, and the area in northeastern Brazil where Ford labor scouts searched for a labor force to carry on the clearing and planting program of 5,000 acres a year. The shaded area in northeastern Brazil was the traditional source of labor for Amazonia during the days of native rubber gathering.

this article are in long tons), of synthetic rubber were produced in the United States, and nearly half a million tons of natural rubber were imported. Even Germany, desperately needing rubber, was able to produce only about 20,000 tons in 1939, and the U.S.S.R. led the world in its production with some 50,000 tons. The total world production of synthetic rubber was only 7.5 per cent of the world production of natural rubber in 1939.

In addition to the scarcity of synthetic rubber, its price was 65 cents a pound in 1939 as compared with 17½ to 20½ cents a pound for natural rubber. The price of this chemical material has been reduced from $1.05 a pound in 1935 to its present value. The plentiful domestic supply of raw materials—coal or petroleum, sulphur, limestone, salt, and water—combined with future mass synthesis of these materials will undoubtedly drive the price still lower. Manufacturers believe that it will be possible to initiate such methods within a two- or three-year period. Several large companies in the United States are now producing synthetic rubber as a subsidiary to chemical, petroleum, or natural rubber manufacture.

The properties of synthetic rubber are superior to those of natural rubber for certain uses. If the finished article is exposed to the action of certain oils, fats, solvents, heat, sunlight, air, and in some cases, abrasion, the performance of elastomers is at least equal to natural rubber. Experiments with synthetic rubber in tire manufacture indicate that it may be used for this purpose.

Synthetic rubber, then, will be an increasingly important contributing factor to the solution of the problem of supplying our needs in case of emergency. The present scarcity of the

American supply, and the impossibility of immediate expansion of this output, place a time limit of something like two or three years on the tonnage value of this expedient. Synthetic rubber alone is not the solution.

2. *Reclaimed Rubber.*—Reclaimed rubber, together with the stocks of natural rubber on hand, could supply the United States' normal demand for about one year. During the war of 1914–1918, 57 per cent as much reclaimed rubber as natural rubber was used in American industry. The price of reclaimed rubber at about seven cents a pound, is lower than that of natural crude rubber, but its most important use is as a compounding agent, in combination with natural or synthetic rubber. It may be used alone for goods which do not require a high degree of elasticity.

Initial costs of rubber reclaiming plants are high, but this source will prove a temporary stop-gap. It would not, however, give relief to the industry should the need become acute and protracted. The total amount of reclaimed and synthetic rubber used in the United States in 1939 was less than 180,000 tons, and since the total rubber consumption in that year was 578,000 tons, nearly four-fifths of the 500,000-ton import were an immediate necessity. Expansion of neither reclaimed nor synthetic rubber production can quickly wipe out this unfavorable balance.

3 and 4. *Other Sources of Natural Rubber.*—The remaining alternative sources of rubber include the parts of

FIGURE 2.—General view of part of the Fordlandia plantation. Terracing is a necessary technique on this highly dissected plateau rim. Note the horizontal stocks and boughs between the terraces, laid in an attempt to prevent soil wash until the cover crop could become effective. Temporary shelter for laborers is located at the bottom of the terraced slope. Evidence of erosion and abandonment are observable on the opposite valley side. The picture was taken in 1931 by a member of the Fordlandia staff.

tropical America which have between 70 and 120 inches of rainfall a year where the *Hevea* trees can be grown, and the drier parts of Central America where the guayule plant flourishes. Dry land or mid-latitude plants do not yield latex in as large a quantity as do humid tropical varieties of latex-producing species. Mexico produced less than 5,000 tons of guayule rubber in 1939. Estimates have been made that it would take at least five years to bring guayule bushes into anything approaching large scale production.

No combination of substitutes for natural *Hevea* rubber from southeastern Asia can at present or in the immediate future supply the United States' requirements. All sources other than the Middle East provided approximately 187,600 tons to the United States in 1939, a deficit of 390,400 tons from the normal consumption.

TABLE I

SOURCES OTHER THAN SOUTHEASTERN ASIA OF RUBBER USED IN THE UNITED STATES IN 1939

(Approximate tonnage)

	Long Tons
Recovered Rubber	170,000
Synthetic Rubber	4,000
Mexico	2,500
Central America	100
Brazil, Ecuador, Bolivia, and Peru	5,500
Africa	5,500
Total	187,600
Total Rubber Consumption, United States, 1939	578,000
Total Other Than the Middle East	187,600
Necessary Import from the Middle East	390,400

Relocation of Plantation Production.—Relocation of the source of natural rubber would be a long term solution to the problem. The only new orientation of plantation production which would obviate a long ocean haul would have to be in the rainy tropics of the Americas. This area comprises the eastern Trade Wind Coast of Central America, the northeastern littoral of Brazil, and the Amazon Basin. The *Hevea brasiliensis* is indigenous to Amazonia, and although the high yielding species of Malaya, Sumatra, Ceylon, and Indo-China are clonal, or cross-bred, varieties of this tree, natural conditions in many parts of tropical America are suitable for rubber production. It requires from five to seven years for *Hevea* species to reach tapable age in Malaya and Sumatra, and in Amazonia the short dry season increases this time to nearly ten years. Thus a new area of plantation production will not contribute materially to the current exigency.

Various governmental and private agencies have been interested in the rubber potential of tropical America. Since some three-quarters of the American rubber consumption are used in the manufacture of tires and tubes, the most determined efforts toward establishing modern plantation production in this region have been undertaken by two companies operating the automotive and associated fields: the Ford Motor Company and the Goodyear Tire and Rubber Company. The experience of the Ford Motor Company furnishes an interesting example of the problems of plantation relocation.

PLANTATION EXPERIMENT OF THE FORD MOTOR COMPANY

The Goodyear and Ford enterprises have been in different areas. Goodyear has established small plantations in Costa Rica and Panama, and the Ford Motor Company, through its Companhia Ford Industrial do Brasil, has two plantations, Fordlandia and Belterra, comprising nearly 2,500,000 acres of concession land on the eastern bank of the Tapajos River, a north-flowing tributary of the Amazon (Figure 1).

There are at least four major requisites to the establishment of a successful

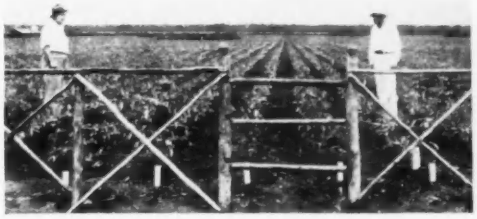

FIGURE 3.—The low relief of the plateau at Belterra presents no soil erosion problem. The picture, taken in 1935 by a plantation official, shows the Belterra nursery in which there were four and a half million seedlings. Note the tall-trunked tropical trees crowding the clearing, and the sawmill at the left, behind Mr. Archie Johnston, plantation manager at that time.

rubber plantation: (1) adequate land, fulfilling the minimum requirements of fertility and slope; (2) large amounts of capital; (3) labor which is physically and psychologically able to work on the plantation, and (4) a climate warm enough and wet enough to insure normal development of the tree. These conditions do not include economic factors of market and accessibility.

Three of the four requirements of plantation production are fulfilled at the Ford plantation. Land and capital are available in quantities sufficient to insure the success of the venture. The Companhia Ford Industrial do Brasil has invested nearly $9,000,000 in the project; and the State of Para, Brazil, originally ceded 1,000,000 hectares (2,500,000 acres) of unowned land about 110 river miles south of the confluence of the Tapajos and Amazon rivers.

This 1927 concession was named Boa Vista, and later Fordlandia, but the area was found to be too strongly dissected for efficient cultivation of rubber (Figure 2) and in 1934 the State exchanged the southeastern 686,000 acres of the Fordlandia plantation for an equal area 80 miles farther downstream (Figure 1). The new site, Belterra, is only 30 miles from Santarem, at the confluence of the Tapajos and the Amazon, and is within the dry season headwaters of navigation on the Tapajos. It is on a part of the plateau which has a slight southeastward dip but virtually no local relief (Figure 3). Fordlandia is now being used exclusively as an experimental plantation, and Belterra is being prepared for active production. The rainfall requirement of rubber is more than satisfied by an 11-year average of 88 inches at Fordlandia and a five-year average of 94 inches at Belterra. The dry season from July to October slows down but does not prevent the growth of the *Hevea*.

PROBLEMS OF THE FORD PLANTATION

All production problems except one are being solved with varying degrees of success. Soil erosion control is not serious at Belterra, and is accomplished by cover crops and terraces at Fordlandia (Figure 4). Soil fertility is mantained by leguminous cover and by fertilization (Figure 5). Company authorities feel that the South American leaf disease is being overcome by clonal experiments with *Hevea benthamania*, *guiamensis*, and *spruciana* as well as the thinner leafed *Hevea brasiliensis*. Land, capital, and climatic requirements are fully met in the Amazon basin but the last necessity, labor, is seriously limiting expansion and production.

LABOR REQUIREMENT OF RUBBER PLANTATIONS

In June, 1940, there were 19,130 acres of land planted to rubber trees on the two plantation sites. These acres required the presence of 2,316 laborers who, with their families, made up a total population of nearly 10,000 (Table II). It is estimated that 76,000 acres of producing trees will be necessary to

supply the needs of the Ford Motor Company, and the Company had hoped to meet this acreage need with a clearing and planting program of 5,000 acres a year. Two to three hundred men are required to clear, burn, hole, and plant an area of 5,000 acres, and the labor requirement for tapping and maintenance is at least five times greater than that for the steps from clearing to planting. One man can tap 300 to 350 trees a day on alternate days, and on the basis of 100 trees per acre a single laborer is able to tap between six and seven acres. Thus the total program will require a labor force of about 11,000 tappers alone.

The Amazon region cannot supply this need. Population densities are generally less than one per square mile, and most of the natives who might be induced to the Tapajos plantations are either physically or psychologically unfit for employment by the Company (Figure 6). A strict medical examination is required, and great numbers of applicants have been refused because of illness. In addition two-thirds of the men hired leave because they do not feel comfortable with a position requiring a set number of hours of continuous effort a day. The workers of Amazonia prefer "task" or piece-work employment. This fact has led the Company to undertake much of the clearing, burning, holing, and weeding on a contract basis, despite the fact that the system is not considered thoroughly satisfactory by the management. Twice as many workers at Belterra were contract workers in June, 1940, than were on hourly wages. Of a total of 900 laborers hired at Belterra during the first half of 1940, 600 left their jobs because they preferred contract work to regular employment. Virtually all the

FIGURE 4.—Native laborers constructing contour terraces along the sides of a small valley on the Fordlandia plantation. Terracing proved necessary to prevent soil erosion on the steep slopes of the valleys which were encountered at this site. Soil wash on the slopes and poor drainage in the valley bottoms caused the abandonment of large areas at Fordlandia, and contributed to the decision to cease clearing operations on this site. The picture was taken in 1931 by a member of the plantation staff.

TABLE II

NUMBER OF EMPLOYES BY DEPARTMENTS, JUNE, 1940, COMPANHIA FORD INDUSTRIAL DO BRASIL

Dept.	*Salary*	*Hourly*	*Contract*	*Women and Contractors*	*Total*
Belterra					
Construction and Maintenance	3	107	...	43	153
Sawmill	..	15	...	29	44
Plantation Field and Nurseries	10	372	670	566	1,618
Storage	1	16	...	...	17
Garage	..	25	...	...	25
Power and Supply	1	22	...	1	24
Medical	10	26	...	12	48
Others	16	73	...	21	110
Totals	41	656	670	672	2,039
Fordlandia					
Construction and Maintenance	..	41	...	...	41
Plantation Field and Nurseries	3	201	...	4	208
Stores	1	5	...	...	6
Garage	1	3	...	...	4
Power	1	9	...	...	10
Medical	6	22	...	6	34
Others	9	21	...	6	36
Totals	21	302	...	16	339

laborers at Fordlandia were hired on an hourly basis, but no expansion is being attempted on this site.

The continuance of clearing and planting operations depends on the location of an adequate supply of labor, and the Company undertook a recruiting search not only in the Amazon basin, but also in the northeastern states of Piauhy, Maranhão, Pernambuco, Parahyba, Rio Grande do Nort, and Ceara (Figure 1). This northeast region was the traditional source of labor for the Amazon rubber regions during the boom period.

The conclusions reached by the Company in regard to availability of labor in northeastern Brazil are:

1. There are thousands of idle men in northeastern Brazil at the dry period of the year (July to October).
2. There are few idle men who are able to work in this area after the rains start.
3. There are many idle men during both dry and rainy seasons, but because of disease and blindness they are not fit to work.
4. Due to the closing of public irrigation works, a few hundred men could be recruited.
5. Recruiting would have to be done on a systematic basis, and by a Brazilian.
6. A doctor would have to be hired or taken from the plantation, because 75 per cent of the places visited had neither a doctor nor a nurse.
7. All costs of transporting men and families, and feeding them en route from the place of hiring to the plantation would have to be borne by the Company, as the only people who would migrate to the Tapajos are those without financial reserves.
8. The average cost of hiring men in northeastern Brazil and placing them in a position to work on the plantation would be:

Cost of single man	375$006*
Cost of man, wife, and four children	1:125$000
Cost of man, wife, and six children	1:375$000
Cost of man, wife, and seven children	1:625$000
Cost of man, wife, and eight children	1:875$000
Cost of man, wife, and ten children	2:250$000

*The Brazilian milreis, indicated as 1$000, was valued at $.0515 between January 22–27, 1941. The conto, written 1:000$000, is 1,000 milreis. At par the milreis is valued at $.546.

9. The medical inspection will have to be relaxed if any considerable number of laborers are to be recruited because a large percentage of the people are diseased.
10. It might be possible to recruit two or three hundred men a year for two years. This number would serve to carry on the clearing program for two years, but would not be adequate to support the plantation on a production basis.
11. Men from northeastern Brazil are not anxious to go to the Tapajos region.
12. Although population movements are common during a "secca" (long dry season), the migrants almost invariably return to their homes as soon as the rains start. In 1932, 300 families were taken from Ceara to Para at state expense, but shortly after these families were settled in Para it began to rain in Ceara, and in six months not one of the immigrant families remained in Para.
13. Nearly all available labor in northeastern Brazil has been recruited by scouts from the State of Sao Paulo, and there is still a labor shortage in that state.
14. The daily wage of 7$000 at Fordlandia and 6$000 at Belterra, although some 35 per cent above the average for the Amazon region, together with free house, light, school, water, garden space, and medical care, including hospitalization for the laborer and his family, is not sufficient inducement to bring physically fit workers to the Tapajos.

According to these conclusions the potential labor supply of Brazil falls far short of the needs of the Companhia Ford Industrial do Brazil alone, which at best would produce 38,000 tons of rubber a year. It is impossible, then, to expect an important development of plantation rubber production in the Amazon Valley unless other sources of labor are tapped to supplement the native demand.

ALTERNATE SOURCES OF LABOR FOR THE FORD PLANTATION

Several alternate sources of labor have been considered by the Companhia Ford Industrial do Brasil. Opinions have been obtained that Tamil, Chinese, Javanese, and Puerto Rican laborers would best satisfy the requirements of plantation production. The first three of these groups have been used to advantage in the groves of southeastern Asia, where the Chinese tappers are paid the highest wages of any labor group. Puerto Rican laborers are untried as rubber gatherers, although they have proved satisfactory under some-

FIGURE 5.—Steep terraced hillsides at Fordlandia. Low-growing leguminous cover crops may be seen planted between the terraces to help prevent soil erosion. Such slopes wash seriously when cleared, unless protected by terraces and cover crops. Because terracing increases expense of operation at Fordlandia, the plantation has been abandoned in favor of flatter terrain at Belterra. Fordlandia is now devoted to experimental activities. (Courtesy of the Ford Motor Company.)

what comparable climatic conditions on sugar plantations in the West Indies.

Immigration restrictions make it difficult to import labor into Brazil. All labor groups are subject to the quota restriction that "the number of aliens of one nationality admitted to the country shall not exceed the yearly limit of two per cent of aliens of that same nationality admitted to Brazil in the last 50 years." This quota limits each desirable group to approximately 100 a year, and although a sufficient number of individuals from several national groups might be imported, the expense of recruiting and transportation would be increased per individual. In addition such a mixed labor force might prove undesirable. Immigration quotas do not apply to Portuguese labor, but this source will not be a fertile field for rubber plantation labor scouts.

Even without quota restrictions imposed by Brazil, the restrictions and contract qualifications such as those outlined below for Puerto Rican emigrants make it difficult and expensive to transport labor from over-populated areas of the Western Hemisphere to the Amazon.

FIGURE 6.—Native hut in the Amazon Valley, taken in 1931 by one of the Fordlandia labor scouts. It proved difficult to induce laborers to leave these dwellings even when homes such as that shown in Figure 7 were promised.

CONDITIONS UNDER WHICH LABOR MAY BE RECRUITED IN PUERTO RICO FOR EMIGRATION ABROAD

1. No laborers under 16 or over 70 years of age may emigrate, unless accompanied by their parents or legal guardian, or by their children or some member of their family.
2. Transportation from Puerto Rico to the place of employment, medical examination, clothes, shoes, etc., are to be provided by the employer.
3. There must be a statement as to how many months' work a year will be provided, and the minimum wage to be paid the emigrant.
4. Adequate schools, social halls, and community houses must be furnished by the employer.
5. Adequate food at reasonable prices shall be provided by the employer.
6. Sanitary housing facilities shall be provided by the employer.
7. Payment for labor shall be made in legal currency of the United States, or its exact equivalent in money of the place where the workers are going to live.
8. Compensation shall be paid in the event of incapacity or inability of any type.
9. Hospitalization shall be provided in case of accident, or for any disease contracted between the time of the accident, and the time of final release from the hospital.
10. Compensation shall be paid in case of the death of a worker, due either to an accident, or to a disease consecutive to an accident received while engaged in line of contracted work.
11. Insurance shall be provided by the employer.
12. There shall be an eight-hour day and a 48-hour week.
13. A bond of $5,000 shall be posted with the Department of Labor of Puerto Rico to cover any claim

FIGURE 7.—House at Fordlandia furnished by the company to the native laborers. Free light, water, house, school, and hospitalization are offered to laborers and their families, yet it has been impossible to develop an adequate source of workers. Nearly 11,000 people are now in residence in such houses as this on the Fordlandia and Belterra plantations. (Courtesy of the Ford Motor Company.)

against the employer, and to cover any expenses of investigation of such claim.

14. The contract shall be guaranteed by a legal representative of Brazil, which country must guarantee to repatriate to Puerto Rico any laborers who, after a fair trial, decide to return to Puerto Rico.
15. Disputes arising under the contract shall be submitted to the courts of Puerto Rico for settlement.
16. Workers accepting the contract are obliged to live up to the terms of the contract, and to observe a good moral conduct, and to abide by the regulations that the employer may think necessary for the efficiency of the work.

CONCLUSION

The future of Amazonia as a plantation rubber region lies in the development of an adequate labor supply. A labor shortage exists throughout the more advanced areas of Brazil, and despite the relatively high wages, free housing, hospitalization, and schools offered by the Companhia Ford Industrial do Brasil, the labor available in northeastern Brazil prefers to move to Sao Paulo rather than to the Amazon Valley (Figure 7). Disease and lack of numbers make the population of the Amazon Valley itself unable to support a plantation.

The experience of the Ford Motor Company in attempting to set up a rubber plantation on the Tapajos River indicates that unless a mass migration of labor from abroad can be arranged, any further expansion of plantations in Amazonia is impossible. The difficulties to such migration are quota restrictions of Brazil and contract and traveling expenses of importation of labor from other regions.

It has been suggested that rubber trees may be planted by individual natives in tropical America, and that the latex be collected at some central point. However, this system would require more individual supervision than a plantation, and such supervision would be more expensive than on a plantation because of the increased area involved. Coöperation between the United States government and the governments of the areas involved would supply the capital and scientific knowledge required for such a project, but the inertia of an inadequate labor supply would destroy the tonnage value of this plan.

None of the alternative sources of rubber could supply the requirements of the United States at present. Restrictions on use of rubber products, immediate development of synthetic rubber production, and reclaimed rubber may prove to be temporary expedients, but unless the inadequacy of Brazil's labor supply is obviated, the United States must remain dependent on southeastern Asia for its natural rubber.

A RECONNAISSANCE OF SOME CULTURAL–AGRICULTURAL ISLANDS IN THE SOUTH

Walter M. Kollmorgen

AMONG the cultural-agricultural islands in the South, the communities fathered by Mr. Hugh MacRae at Castle Haynes and St. Helena, about 20 miles north of Wilmington, North Carolina, are unique. Mr. MacRae, one of the outstanding businessmen of Wilmington, has in the last three decades spent several fortunes—as most of us conceive of fortunes—in colonization efforts. The developments at Castle Haynes and St. Helena represent his most successful efforts to transplant people to the South to develop intensive agriculture. They are, however, only a part of his agricultural promotion work. Of perhaps equal significance are his experiments with year-round pasture programs. In this work, Mr. MacRae is undoubtedly the outstanding pioneer in the South.

Castle Haynes and St. Helena, North Carolina

The Atlantic Coastal Plain at Wilmington is largely given to marshes, swamps, sand barrens, and a variety of sandy soils of rather low fertility. From an agricultural standpoint, much of the land is sub-marginal. Mr. MacRae, however, long ago decided that the land had unexplored possibilities and resolved to discover what these possibilities were. He read widely on agricultural practices, and several decades ago came across a publication entitled *Ten Acres Enough*, by Edmund Morris (1905), first published in 1864. This provided the germ of his experiments. As the title clearly suggests, the publication advocates intensive farming. An indirect benefit of such farming is a proximity of homesteads and the opportunity for social intercourse. Such opportunity Mr. MacRae considers essential in a successful plan of rural life.

Mr. MacRae, himself a graduate of the Massachusetts Institute of Technology, employed experts to select soil areas for his settlements. As might be expected, these specialists chose soils with fine-textured subsoils, types suited to retain soil amendments.

Mr. MacRae soon found that Southerners were unsuited for his experiment so he went to the expense of aiding some selected European peasants to migrate to this country. Immigrants from various countries were obtained. Among these were thirty families from a village in Italy which had a remarkable record with reference to the absence of crime. These families, brought over before the World War, immediately set themselves to the task of raising grapes and making wine. Then came Prohibition and the War. Industry afforded plenty of jobs at high wages. All but two families left. About ten families were then brought over from Belgium, but these also were soon attracted to industrial centers and well-paying jobs.

The great expense involved in bringing immigrants across the Atlantic led to the successful experiment of selecting farm-minded foreign-born immigrants from Northern industrial centers. A variety of cultural groups are now represented in the settlements: white Russians, Italians, Germans, Hollanders (Dutch), Poles, and Hungarians. The Dutch farmers in Castle Haynes are

among the most enterprising and successful. Mr. MacRae believes that this settlement has more brain power per acre than any other settlement in the South. Besides being excellent producers of truck crops, the Dutch successfully introduced the raising of bulbs and flowers. Import restrictions on bulbs from Holland gave them an exceedingly profitable market for their bulbs in this country. The Dutch, however, as all other farmers in these communities, raise a great variety of truck products and other farm products. Lettuce, beets, carrots, snap beans, cucumbers, and other vegetables are shipped North by carloads.

A conversation with a mother and daughter working in the field (summer of 1937) revealed that their family alone had shipped four carloads of lettuce to Northern markets and in addition had produced and was producing enough vegetables to fill several additional carloads. Negroes are hired in considerable numbers to help at various operations in the fields. Both mother and daughter were barefooted. The daughter was attending college but worked, and worked with pleasure, in the fields during the summer. This practice, of course, stands in marked contrast to the prevailing habits of the middle and upper classes in the South, particularly where Negroes are numerous.

The settlements have been highly successful and the standard of living of the settlers is high, particularly in the Castle Haynes group. None of the settlers started with more than a few hundred dollars in assets; some contracted a substantial debt to get started. Today some of the operators are worth over $50,000. Many of them have property and other assets worth $10,000 and upwards. The original 10-acre tracts on which the settlers were started have been enlarged to average holdings of about 20 acres. Some of the families have taken trips to California and Europe.

The success of the communities may be credited variously. Mr. MacRae provided agricultural experts for his settlers during the years when they needed to make many adjustments in their new home. The experts gave invaluable aid. The settlers, however, were already familiar with many techniques essential in intensive farming. Mr. MacRae insists that the cultural conditioning and background of a people is extremely important in determining their success or failure as farm operators. He believes also that it is advisable to mix cultural groups so that each group may contribute its best techniques to the agricultural pattern evolved. The mixing process, in addition, helps socially and stimulates the adoption of the English language.

There is an interesting contrast between the success of the Dutch in the Castle Haynes settlement and the failure of a Dutch settlement in North Dakota. Several decades ago from 60 to 70 Dutch families were settled on the rolling plains of North Dakota, under the auspices of Prof. Shepherd of the State University. Many precautions seem to have been taken to assure the success of the settlement; however, the experiment was a complete failure. Bercovici quotes Prof. Shepherd as follows on the experiment: "The reason they have failed was because the land was too good. Rolling plains for Dutchmen! You should have settled them upon marshland in which they would have to dig ditches, standing knee-deep in the soft mud and you would have seen them thrive." (See Konrad Bercovici, *On New Shores*, pp. 169–170.)

Mr. MacRae has also done outstand-

ing pioneering in the South in the development of year-round pasture programs. Since many farming attempts in the South have failed because of lack of good pastures and since the section is badly in need of cover crops and stock, these experiments were briefly investigated. This work was, frankly, the most promising discovery—discovery for me—made in the South.

The long growing season and mild climate on the eastern coast of North Carolina make it possible to grow a variety of plants to provide grazing opportunity the year around. This holds also for the greater part of the South. Mr. MacRae has experimented with a great variety of plants as well as with numerous ways of cultivating them. He has found it advisable to plant these pasture crops in rows and to cultivate them. Some crops are grown in mixed stands while others serve best as pasture when planted alone. For summer pastures, Mr. MacRae recommends Biloxi soy beans, Sudan grass, Desmodum (Beggarweed), Johnson grass, and lespedeza. For fall, winter, and spring pastures he recommends cold-resistant oats, abruzzi rye, beardless barley, bur clover, crimson clover, Vetch, Austrian peas, and Black Medic. (Mr. MacRae has published his recommendations on year-round pastures in a little booklet entitled *Continuous Grazing at Invershiel.*—Invershiel is the name he has given to his large dairy farm about 12 miles north of Wilmington.) Obviously, a variety of these crops must be grown and the grazing rotated among the separate fields. All these crops provide an abundance of forage. Moreover, many of them being legumes, they improve the land. Periodically, good crops of corn or barley can be grown on such land at a slight fertilizer cost. Some soil amendments are, of course, required because the soils are leached. Marl is plentiful in the area and can be applied at very little cost.

The pasture program lends itself well to both dairying and stock raising. Meat stock could be grown on these pastures and fattened with barley and corn produced in a rotation scheme. Mr. MacRae maintains a large, well-producing dairy herd on his farm (Invershiel) north of Wilmington, and if the program is carried out properly, no hay, silage, or concentrates are required as feed. Mr. MacRae keeps an unusually careful record of his farm expenses, and by the summer of 1937 he had demonstrated that he produced dairy products at a cost more than 50 per cent lower than is typical or usual in the state. And he believes that he can improve this record by as much as 15 to 20 per cent. (With no outlay for hay, silage, grain, and concentrates, and only a modest cost for shelter, Mr. MacRae has a tremendous cost advantage over the farmers of the North and Middle West.)

As an interesting exhibit, Mr. MacRae maintains what may be called a traditional Southern (or even Northern or Western) pasture. He refers to this as his "mule gymnasium," since it provides almost no feed but is a good place for the mules to wear off extra energy during slack working seasons. Adjoining this traditional pasture are his cultivated pastures with forage so plentiful and high that hogs and calves may be completely hidden by the plants. Mr. MacRae's pasture experiments seem of extreme importance for the South. Numerous attempts at diversified farming in this section have failed largely because ordinary "grass pastures," as found in the North, failed to grow. However, it is not written on eternal tablets that such pastures are essential in stock raising. Even in

the North and West such fields are frequently starving grounds many months of the year. Only under an inflexible agricultural program could the discovery of the possibilities of annual rotation pastures have been delayed so long.

RIDGEWAY, NORTH CAROLINA

During the 1870's and 1880's a number of German families, most of them directly from Germany, established themselves near Ridgeway, North Carolina. Today there are about 40 families in this cultural-agricultural island. Ridgeway is located on the eastern edge of the Piedmont in Warren County, which is prominent in the production of both cotton and tobacco. Negroes compose about two-thirds of the population of the county.

Since their arrival in the South, the Germans at Ridgeway have been noted as an extremely industrious people. An outsider observed that "they work like the devil." Their activity does stand in marked contrast to the leisurely pace—frequently no pace at all—of the native white proprietors, who are not noted for direct productive activities. As in other sections of the South where they are numerous, Negroes perform most of the manual work. The Germans also hire Negro help, but instead of merely giving the Negro directions, they usually accompany him into the field and work with him. As a result, the quantity and quality of work which the helper performs seems to be much above the average for the South.

In 1930, 93 per cent of these Germans were either full owners or part owners, or rented from relatives; the corresponding figure for a white control group in the county was 66 per cent and for a Negro control group 33 per cent. (Full data were gathered from the original farm schedules in the Bureau of the Census for the island as well as for two control groups, one white and one Negro. When the community was revisited recently, the local pastor [Lutheran] said that all his members are now owners and that they have little difficulty buying all the land they can operate from nearby large landholders who are in serious financial difficulties.) Cotton and cantaloupes are the main cash crops of the German farmers, but they also produce a great variety of other crops. They have big barns, keep more stock than native farmers, and do more milking. Their cantaloupes, which have been trademarked "Pride of Ridgeway," command a premium on Northern markets. Some of the German farmers raise large quantities of berries. Few of them raise tobacco. One of the most prosperous farmers in the community has made a small fortune on 20 acres by raising blackberries. When berries were high, he sold berries; when berries were low, he sold wine. These Germans have carried on soil conservation practices for several decades. Prior to the present government program of terracing, many of them terraced their lands with home-made devices. In comparison with their neighbors, they plant more cover crops and apply more manure to the land. In general, they maintain unusually productive farms. These observations are of course relative. Various farming improvements can and should be made by these people. Their terraces and cover crops, for example, are not adequate to prevent sheet erosion. The fact remains, however, that they use farming methods highly superior to the methods traditional in that section.

The versatility of the Germans at Ridgeway in their farming practices was well illustrated in the summer of 1937 when a severe hailstorm completely

ruined many of the cantaloupe fields. Immediately the ruined fields were plowed and planted to other crops. One farmer planted beans, and the return on this crop exceeded the income cantaloupes would have brought at prevailing prices. Outside the island were the cotton and tobacco growers, a high percentage of them Negroes. Many of these native farmers interpreted the hailstorm as an act of liberation from further work responsibilities for the year. Relief and charity were resorted to. In part, this difference in response may be attributed to the credit and financial standing of these respective groups of people. The Germans either had the means to put in the new crop at once or they could get all the money they needed from the bank. The others, hardly knowing what it means to farm on a cash basis, had already borrowed to the limit. The complacency with which the average Southern farmer accepts credit farming is most revealing and disturbing. Hundreds of interviews have led to the conclusion that credit farming has become an accepted pattern. Negroes particularly are given to this attitude. One cannot say that they are resigned to it, for few seemed ever to have speculated on the possibility of farming any other way. This attitude stands in marked contrast to the passion the average immigrant usually demonstrates to own and to get ahead, to operate with cash.

Valdese, North Carolina

Valdese, North Carolina, is located in the dissected western portion of the Piedmont of the state, in Burke County. The mantle rock here is generally thin, and rock outcrops are frequent. The soil is consequently thin and readily exhausted, and erosion is a major problem on broken land. Much of the land around Valdese was still forested during the 1890's when an attempt was made to establish a settlement of Italians (Waldenses) in this section. About 40 families came from northern Italy in 1893. In their native land they had farmed for centuries in a highly rugged section and had performed all their cultivating operations with spade, pick, hoe, and other hand tools. Their thoroughly diversified farming abroad included the raising of stock and the production of grapes, potatoes, and wheat.

Promoters of the Valdese settlement felt that these traditionally hard-working Italians would be successful in an environment similar to that of their native land. The newcomers, with customary thoroughness, cleared the land of its many trees and rocks. Known agricultural techniques were applied in a diversified program of farming. Thorough application, however, did not suffice. Agriculturally, the settlement was a failure, and most of the families have been absorbed by the various textile plants in Valdese.

The reasons for the agricultural failure of the settlement are many and cannot be considered here. It should be noted, however, that merely back-breaking work does not assure success in agricultural undertakings in the South. Among other things, the slope lands of the South are extremely difficult to handle in a farming program largely given to tilled crops.

Colonial Germans in North Carolina and Tennessee

From 1683 forward there occurred a large migration of Palatinate Germans to southeastern Pennsylvania. (Albert B. Faust, *The German Element in the United States* [1927]. Faust estimates that by 1775 there were 120,000 Germans in Pennsylvania, representing about a third of the population.)

After 1700, many of the Pennsylvania Germans spread into western Maryland and the Shenandoah Valley of Virginia. It seems to be clearly established that they became the dominant cultural group in the upper portion of the Valley. By 1740 some of them followed the passes through the Blue Ridge and settled in northwestern North Carolina. (Faust estimates that by the time of the Revolutionary War there were about 8,000 Germans in North Carolina.) To this day many of them can be identified by their affiliation with the Lutheran church.

During the early period the colonial Germans in western North Carolina were largely isolated since river transportation did not reach them and wagon transportation was expensive. Consequently a self-sufficing form of farming was instituted and is largely followed to this day. Cotton was grown only in very small quantities, because the growing season is too short in this section of the Piedmont. Some of these people have become rather outstanding farmers. In the more accessible places the group as a whole seems to do fairly well in some form of diversified farming.

The colonial German farmers in North Carolina are not so prosperous as their "kin folk" on the fertile limestone lands of the Shenandoah Valley and southeastern Pennsylvania. Testimony on their competence as farmers varies. While some claim that they have been absorbed agriculturally, others assert that they represent a somewhat more stable and enterprising group of farmers than their neighbors. It seems to be generally agreed that they are outstanding in their practice of living rather well on a self-sufficient basis even with small cash incomes. Some believe that the percentage of land ownership is higher among them than in other groups. Conditions vary somewhat from place to place and few if any generalizations should be made without a detailed and careful study. Much has depended on opportunities and immediate environment. For instance, in rugged Boone County some descendants of colonial German stock have become completely metamorphosed into "mountain folk" or "hill billies." The frontier and isolation apparently conquered them completely.

Many of the colonial Germans and their offspring in southeastern Pennsylvania, the Valley of Virginia, and the Piedmont of North Carolina migrated southward and westward, and a considerable number of them must have settled in Tennessee. The one-time or present location of a Lutheran church seems to be an unfailing tell-tale of their location. In the state of Tennessee there are at present nearly 20 rural Lutheran churches, and some of these church communities were visited.

One of the largest colonial German settlements in Tennessee at present is between Newport and Greeneville, in Cocke and Greene counties. This settlement dates back to frontier days, around 1800. It seems that most of the settlers came from southeastern Pennsylvania. In their new location they found a limestone soil similar to the soil they had left, but an area with much slope land because of dissection, as well as numerous precipitous sink holes. The present descendants of these pioneers are sufficiently numerous to maintain several churches. It is estimated that there are at least 200 farmers in this section with distinctly German names.

In the light of the historian Turner's observations on the "crucible of the frontier," these German descendants provide an interesting subject for study. As a group, they have to this day

retained a degree of diligence, thrift, and thoroughness which sets them apart from other farmers in the section. On this point complete unanimity of opinion prevails among those who know them and are competent to render judgment. Inquiries about them brought responses as follows:

"They work harder than most farmers."

"They are farmers and don't pretend to be anything else."

"They are the nearest thing to a mole we have in this county: they are in the ground all the time."

"A high percentage of them own their land."

"The Dutch farmer doesn't mortgage his land to buy a car."

"They have few farm mortgages."

"They have plenty of cash in the bank."

"They pay their bills."

"They market the best tobacco in this section."

"They are the best eaters we have in the county (as a group) and most of the stuff comes right off the place."

"Those people are not on relief."

Estimates on the differential in land values resulting from more thorough farming practices ranged from 20 to 25 per cent higher for land and about the same for improvements. Local Lutheran ministers claimed that over 90 per cent of their members were owners whereas in the counties generally (Cocke and Greene) only about two-thirds of the farmers are owners. Clearly the frontier crucible has not removed all the distinguishing cultural characteristics of these colonial Germans.

A group of Pennsylvania-North Carolina Germans reached Missouri before the end of the eighteenth century and settled near Whitewater Creek in the counties of Cape Girardeau and Bollinger. Sauer calls them the Whitewater Dutch. Here they were surrounded by Anglo-Saxons and, like their neighbors, they became typically "tall, spare, and sharp-featured." Sauer writes, "They are still in part Lutheran and have been much less mobile than the Anglo-Saxon stock of the region, remaining commonly in their ancestral seats. These are as a rule the best farms in that section." Carl O. Sauer, "The Geography of the Ozark Highland of Missouri," *The Geographic Society of Chicago Bulletin No. 7.*

A small number of colonial Germans also settled in Franklin, Lincoln, and Bedford counties, Tennessee. Formerly there were as many as five or six Lutheran churches in these counties. At present only two of these churches remain, both in Bedford County. All these settlements were small, inadequate in number to maintain what sociologists term "in-groups." Agriculturally and every other way these people seem to have been absorbed by the dominant groups. Their farming practices do not set them apart as do the practices of later immigrants, but some observers are of the opinion that they are somewhat outstanding in their standard of living on a self-sufficient basis.

South Carolina

A number of German and German-Swiss settlements in South Carolina are of particular interest because they furnish at least a partial test of the influence of environment, both social and physical, on the activities of a people. Their founders came to this state about 200 years ago (1733 forward) and, like the early German settlers in Pennsylvania, they came from the Palatinate. The two groups therefore had the same cultural background in Europe. In the New World, however, they have lived in dissimilar environments. The question arises: What

similar cultural-agricultural traits have persisted in these dissimilar environments? The Germans in Pennsylvania from colonial times forward have been classed among the most outstanding farmers in this country. The Germans and German-Swiss in South Carolina so far seem to have received very little attention from historians and agricultural writers.

The early German and German-Swiss settlements in South Carolina were scattered throughout the southern part of the state. (Faust estimates that by the time of the Revolutionary War there were about 15,000 German settlers in the state of South Carolina.) At present the offspring of these people who are engaged in agriculture live mainly in Saluda, Lexington, Newberry, Orangeburg, Richland, and Barnwell counties. In general, they may be identified readily through their affiliation with Lutheran churches. Agriculturally they have not been fully assimilated. They have proved themselves better stewards of the land than their neighbors. Paul B. Sears writes of them as follows in his *Deserts on the March:* "There is today in South Carolina an area which has long been occupied by Germans. All around it is desolation, caused by erosion. This erosion of course was induced by improper soil management. Within the area in question erosion is comparatively slight, although the physical character of the land is like that of the surrounding region." They give much emphasis to truck farming and also carry on a more adequate live-at-home program than do the other Southern farmers. They give more emphasis to the raising of wheat. Their living and farming program has rendered them strikingly free from the need of relief. They are referred to as "hard-working people."

From casual observation it seems that the colonial Germans in South Carolina retained distinct cultural characteristics as long as they remained fixed and retained in-group associations, largely built around church affiliation. As members moved westward and the in-group associations were lost, their cultural characteristics, it seems, were merged with the prevailing group

WARTBURG, TENNESSEE

At Wartburg, in eastern Tennessee, there is the remnant of what appears to be the oldest German settlement in the state, settled by people who came directly from abroad. It seems that more than 200 German and German-Swiss families came to this place between 1845 and 1855. They came to this country in response to greatly exaggerated and misleading advertising appeals. Wartburg was to become a thriving industrial center in the midst of a thriving agricultural community. When the Germans arrived, the area was still almost completely forested and was sparsely settled by people of Scotch-Irish extraction.

Wartburg and the surrounding farming district are located on the margin of the Cumberland Plateau. The elevation is about 1,100 feet, whereas the plateau in the area generally lies at a higher elevation. The bedrock is sandstone, and the soil is sandy and deficient in essential minerals and humus. Whatever fertility new land possesses is readily exhausted and manure does not supply all the necessary soil amendments.

Since the Germans settled this new country when commercial fertilizers were practically unknown, and since many of their known grasses and legumes did not grow on the sandy soil, they found it extremely difficult to adjust themselves. Many of them

left after staying on the land but a short time, particularly those who had not engaged in farming abroad. A few industries were started in Wartburg but were shortly abandoned. About 40 farm families of German extraction still live in the section. As a group they are more enterprising farmers than their non-German neighbors. On the whole, they have better and neater homes, a more varied diet—largely because of their gardens—their land is tilled more carefully, and they have practically no relief problem.

Deer Lodge, Tennessee

Whereas Wartburg lies on the margin of the Cumberland Plateau, Deer Lodge, Tennessee, a very small trading center, lies on the plateau proper, about 18 miles from Wartburg. The mantle rock over the sandstone bedrock is rather thin, and the soil is sandy and infertile. The area is maturely dissected and erosion presents a serious problem on broken ground.

During and after the World War, about a dozen Polish families secured small holdings near Deer Lodge and began farming. They paid from $2.00 to $4.00 per acre for the land. The area was in part covered by second growth timber, and there were numerous clearings with deep gullies. The natives or mountaineers subsisted by cutting some railroad ties, hunting, grazing some cattle, and raising small patches of corn and potatoes. The fertility of the land was readily depleted and erosion soon ruined cleared, cultivated fields. This problem was met by clearing new tracts every few years for their little patches of crops. It is this type of land that the Poles purchased, and on this type of land they expected to carry on a permanent form of agriculture. They believed that with the use of grasses, cover crops, and manure this would be possible.

To obtain quantities of manure as fast as possible, the Poles gathered leaves in the woods for bedding stock. This practice greatly amused the mountaineers, for they had never heard of such a thing. When the Poles hauled the manure on the fields on which they expected to grow corn and potatoes, some of the natives became concerned and informed the newcomers that manure would poison the corn and potatoes. Moreover, they tried to make it clear that worn-out land was worn out, that only rest would restore it. They had hauled what little manure they had onto road beds, where it served to hold the sand. With great effort, the Poles restored much of the land by filling gullies, by proper plowing, and by planting grasses and cover crops. Today they raise good potatoes and carry on a diversified form of farming. However, their farming practices require an unusually great expenditure of effort and fertilizer costs are considerable. It seems unfortunate that these people and other immigrants on the plateau did not find more suitable places for settlement.

Rugby, Tennessee

Less than an hour's drive from Wartburg or Deer Lodge, Tennessee, lies the small village of Rugby, also on the Cumberland Plateau. The name itself suggests that unusual events have transpired here. A visit to the place quickly confirms this. Near the highway passing through this village a number of strange old buildings are to be seen. A neat little building near the road bears the inscription: "Thomas Hughes Public Library, Opened October 5, 1882." (Perhaps the best known book by Thomas Hughes is *Tom*

Brown's School Days, which went through 66 editions and was widely read in all English-speaking countries.) Not far from the library stands Christ Church, surmounted by a belfry, which in its general appearance and architecture is English. Another building is labeled "Office of the Board of Aid to Land Ownership, Limited." Within it is the great seal of the Board, consisting of the Union Jack crossed with the Stars and Stripes. Other buildings are identified by such inscriptions as "Uffington House," "The Lindens," and "Adena." Here is mystery added to mystery, and the general silence prevailing in the village mocks the investigator who wishes to know what aspirations left behind such landmarks.

Mr. W. T. Walton of Rugby, Tennessee, furnished much of the information about this interesting place and served as a guide through the several buildings that remain. For an excellent account of the settlement, see "Thomas Hughes and His American Rugby," *North Carolina Historical Review*, Vol. 5, No. 4 (October 1928).

Rugby was the scene of one of the most interesting colonization plans ever attempted in this country. The social and economic order prevailing in England during the later half of the nineteenth century gave rise to the Rugby settlement scheme. English society, then as now, was divided into strict social classes. The upper class, the class Americans might refer to as "the aristocracy," found its vocational opportunities strictly limited. A member of this class could not "tuck up his sleeves and follow the plough." Moreover, "If he were so depraved as to indulge in manual labour, he would lose caste among his own relations." As for available and acceptable work, there were at least a hundred candidates for every job. It was this situation which Thomas Hughes, a great idealist, and others tried to relieve by founding a colony in America where opportunity was plentiful and physical labor did not result in loss of caste.

It should be noted that Rugby was not to be a haven for the "downtrodden, derelict part of the English population," but was to receive the upper middle class, people of social standing and economic means. The fact that Thomas Hughes was president of the Board of Aid which undertook this colonizing scheme seems to have been a determining factor in bringing many upper-class young Englishmen to the colony. Former students from Eton, Westminster, Clifton, Bedford, Marlborough, and Wellington crossed the ocean to seek their fortune in this wilderness. In the early 1880's over a thousand young Englishmen, many of whom "knew the dead languages and how to swear like gentlemen," came to Rugby at one time or another. So well publicized was the colony that a steamship company advertised through rates from London to Rugby. (The nearest railroad station to the settlement was about seven miles removed from the center of the settlement.)

The Board of Aid to Land Ownership, Ltd., was incorporated in Tennessee in 1879, and it was in the years immediately following that most of the activity took place at Rugby. The Cumberland Plateau at that time was almost completely forested and was inhabited by a few illiterate backwoodsmen. The Board obtained a controlling interest in over 400,000 acres of land. This rather impressive figure suggests the dimensions of the dream of making Rugby a thriving intellectual center as well as an oasis of advanced agriculture.

Although it was hoped to make Rugby a resort as well as a university center (a hotel was built but no univer-

sity), the founders' interests were mainly agricultural. Thomas Hughes wrote many glowing accounts of the agricultural opportunities provided by the "productive land" on the plateau. Realizing that the young "Englishmen of aesthetic inclinations and agricultural intentions" knew little about farming, the Board of Aid made arrangements to train them in this work. Instructors, however, were largely incompetent. One of them had spent most of his life as butler to the Earl of Galloway. A model English garden was established to demonstrate that "the Plateau was suited to the production of a great variety of vegetables." To turn this opportunity into profit, it was decided to build a canning factory. Such a plant was actually completed in 1883, and labels were printed for the forthcoming output. (The price on these labels was printed in shillings and pence instead of in terms of American money. Similarly, the cost of crossing a toll bridge to the settlement was "for every horse, mule or ass three half-pence.") An old inhabitant in the area recalls that the plant was opened one fine summer day with "right smart speech making and whistle blowing," and following this celebration canning was begun. The one difficulty encountered was that there were not enough tomatoes to last through the first day of operation!

The failure of Rugby as an agricultural community seems to have been foreshadowed from the beginning. In fact, it seems rather credulous of its founders to have considered the project feasible even before it was begun. The young aristocrats who came to the plateau certainly lacked every qualification for farmers. From the very start they demonstrated much greater interest in sports and leisurely pursuits than in the arduous work required to subdue the wilderness. It seems that their first serious efforts were devoted to preparing a tennis court—before they even had a roof over their heads! A dramatic club, a football club, and an archery club soon thrived. Blooded horses were brought to the settlement, and riding horses proved very profitable to a local stable. The library was a popular center; the *Atlantic Monthly*, *Harper's Monthly*, *Century*, and, of course, *London Punch* were in demand.

Mrs. Hamer points out that "Rugbeians dreamed not of so many bushels to the acre, but of the university school to be modeled after the Rugby school of the motherland, of a philharmonic society, of a dramatic club," and that "in the stress of pioneer conditions they complacently indulged in the luxuries of an old and settled community." A facetious account of these people states in part: "At one period their supply of Worcestershire sauce became exhausted and their agonies were terrible to witness. But even this disaster was followed by a greater—this was the failure of *London Punch* to arrive on time." One writer says they "only loafed, grumbled and wrote to the papers."

When the failure of the settlement seemed imminent, a plan was considered of bringing some French and Franco-Canadian peasants to Rugby. Nothing came of this plan. Again, several hundred German families were to be brought to the place, but this plan also miscarried. In 1883 a small number of German families did pass through Rugby, but their destination lay some miles to the west, at Allardt. Of these Germans, some remain and they are still the outstanding farmers in their community. Rugby was a total failure. (Mrs. Hamer points out that part of its failure must also be attributed to "mismanagement, the absence from the colony of its chief director, land difficulties, conflicting titles, overlapping

claims," and a serious typhoid epidemic in the summer of 1881.) This complete failure stands in marked contrast to the record of the Germans at Wartburg, the Poles at Deer Lodge, and the German-Swiss at Gruetli, also on the plateau.

GRUETLI, TENNESSEE

A small settlement of German-Swiss at Gruetli, Tennessee, represents the remnant of one of many colonization schemes to settle the still largely unsettled Cumberland Plateau after the Civil War. By "exaggeration and gross misrepresentation" nearly 100 German-Swiss families were brought to this place in the late 1860's and early 1870's.

Frances Helen Jackson in her M.A. thesis, Vanderbilt University, Nashville, Tennessee, June 1933, entitled *The German Swiss Settlement at Gruetli, Tennessee* (see map of holdings on frontispiece), quotes generously from some of the advertising literature used to attract settlers, and among other exaggerations are the following: "Der Boden ist . . . erster Klasse. . . . Dieses ist ein Viehzucherland erster Klasse. . . . Dieser grosse Landstrich, die zukünftige Heimath einer zahlreichen wohlhabenden Bevölkerung, wird bald nach allen Richtungen von Bahnschienen durchzogen sein und die Eisenmanufactur wird die Handelswege vervielfältigen. Eisen, welches acht Dollars per Tonne in Pennsylvania zu produziren kosted, kann in Ost-Tennessee für einen Dollar und sechzig Cents produzirt werden." The facts are: The soils in the area are fine sandy loams, derived from sandstones, and are highly deficient in phosphoric acid, lime, and humus. The grass is very sparse, of little feed value in later summer and winter, and grazing requires extensive tracts of land. It was years before the settlers received the benefit of a branch railroad line, roads were almost impassable until very recently, and iron manufacture, of course, was never attempted because of the absence of proper raw material (it was tried in some other sections of east Tennessee).

Many good homes were built by the German-Swiss from native lumber. The holdings were cleared in part and prepared for cultivation. It soon became apparent that the soil had little native fertility, and to overcome the deficiency large quantities of leaves were gathered in the adjoining forests, mixed with manure, and applied to the land. The settlers encountered many difficulties and hardships, but one of their most serious problems was the absence of a market for what they did produce. There was no railroad to begin with, roads were almost impassable, and markets were distant. Most of the families abandoned their places and found opportunities elsewhere. Some remained and in 1937 there were still 16 German-Swiss farmers in the community.

The enterprise and diligence of the remaining German-Swiss at Gruetli has won the respect and admiration of students of agriculture. A recent study of the settlement by Charles E. Allred, Selmer R. Neskaug, and William E. Hendrix, entitled *How the Swiss Farmers Operate on the Cumberland Plateau* (1937), says, in part, "Nearly all the operators have remained economically independent through the recent depression, while 72 per cent of the population of the county was on the relief rolls at one time or another." Of the farming practices the same study says: "High crop yields obtained by Swiss farmers are the result of several practices which have been followed for years. Chief of these are: (1) the production and saving of large amounts of barnyard manure,

augmented by leaves gathered from nearby forests; (2) providing winter cover crops for all cultivated land; (3) liberal use of commercial fertilizer; and (4) systematic crop rotation." These practices, particularly (1), (2), and (4) stand in rather marked contrast to the general patch farming and soil-mining type of farming that prevails on the plateau. In general, the farms of these people are neat and well ordered and show that much attention is given to the hazard of erosion.

On the whole, the relief problem on the Cumberland Plateau is very serious. Up to recent years, part-time or full-time lumbering was common. There was also some mining. Lumbering has largely ceased because of the depletion of adequate trees. Some coal mines have been abandoned and others are operated only part time. Earned income is low and irregular.

Another small German-Swiss community is found at Helvetia, West Virginia, likewise on the Cumberland Plateau. This settlement is located even more unfavorably with reference to elevation, slope of land, soil, and isolation than the one at Gruetli, Tennessee. In their eagerness to earn cash money a high percentage of these people have gone on relief or requested relief jobs. It seems strange that such an unsuitable place was selected for settlement.

Those who have studied the farming practices of the German-Swiss at Gruetli seem to be agreed that their energy output is considerably greater than that of other farmers in the vicinity. Their well-kept gardens and fruit trees contribute to a diet enjoyed by few on the plateau. These German-Swiss have demonstrated that with a great application of effort, a reasonably good standard of living can be maintained, even on a low cash income. Even so, the selection of this location for settlement seems unfortunate. With a similar application of effort and talent in more favorable locations these people would have much more to show for their labors.

Lawrenceburg, Loretto, and St. Joseph, Tennessee, and St. Florian, Alabama

From Lawrenceburg, Tennessee, southward into northern Alabama there extends a belt of thin, infertile soil (largely on the Highland Rim and known as the barrens) which was only partially occupied in the 1870's, by small, self-sufficing farmers. A Catholic priest who came South at that time saw the undeveloped land and resolved to promote a number of Catholic settlements from Lawrenceburg southward. Appeals were directed mainly to German Catholics in the North, but some also arrived from abroad.

With characteristic enterprise the newcomers set about their farming, but they soon learned that most of the land was poor, desperately poor. Stock was obtained, kept in stalls bedded with leaves, and great quantities of manure were applied to the land. But crop yields were disappointing. In desperation, many a German farmer hauled alluvial soil onto hills and slope land to build up fertility. But the results were not encouraging.

Some of the settlers drifted back to the North to make a new start. Some remained and with the aid of commercial fertilizer and various rotation schemes developed a fairly successful plan of diversified farming, in which cotton production plays a part. Those near St. Florian, Alabama, seem to have been the most successful, largely because of the market for vegetables and produce found in Florence, Sheffield, and Tuscumbia, Alabama. In view of available

resources, these people have done remarkably well. To this day they are considered the outstanding, most thorough farmers in their communities.

When Jonathan Daniels was gathering material for *A Southerner Discovers the South* (1938), he discussed the South and its problems with R. H. Claggett, editor of the Knoxville *Journal*. Mr. Claggett told Mr. Daniels about the Germans at Lawrenceburg, Tennessee, and their relatively successful farming enterprise. He also told him about the unsuccessful, unenterprising traditional Southern farmers. The differences in the farming methods led Mr. Claggett to conclude that the South was settled by people "who have never liked to farm" but are the offspring of Englishmen who "were city and seaport people looking for gain and adventure, a few for religious liberty, not farmers looking for land." (Quoted by permission of The Macmillan Company.)

CULLMAN COUNTY, ALABAMA

Cullman County, in northern Alabama, is located on the southern extension of the Appalachian Plateau. The elevation of the county ranges largely between 850 and 1,000 feet, and the growing season is about 200 days. Cullman County came into existence in the 1870's. Like the Birmingham section, it was almost completely unoccupied until after the Civil War. The sandy soil on the plateau was considered unproductive by the cotton growers and only a few families had settled on this largely pine forested area. Much of the land had been granted to the North and South Railroad (now the Louisville and Nashville) as an aid to extend its lines to the Gulf. The railroad wished to sell and settle its lands, and in this program it was greatly helped in Alabama by John Cullman, a German from Cincinnati.

The history of Cullman County is exceedingly complicated and only fragments of information can be set down in this report. In and around Cullman, the county seat of Cullman County, several hundred German families settled during the 1870's, '80's, and '90's, largely because of the far-reaching publicity given to the place by John Cullman. The part of the county not occupied by the Germans (from the North and abroad) was taken over almost entirely by Georgia crackers. A greater contrast between two cultural groups in juxtaposition it is difficult to imagine.

The Germans that came to Cullman County were, on the whole, exceedingly poor. They knew nothing about the raising of cotton. They soon found that the soil required great quantities of manure and commercial fertilizer to produce reasonably well. Absence of good grasses rendered the raising of stock a problem; consequently cotton growing was learned from the Georgia immigrants and added to a somewhat diversified program of farming. It was also learned that strawberries, sweet potatoes, and Irish potatoes did well in the sandy soil. Today Cullman County is one of the important strawberry growing centers of the South, and most of the berries are grown by the Germans and their descendants. The county also ranks among the foremost in the state in cotton and potato production. About 90 per cent of the cropland in the county is terraced.

In spite of modest incomes, the German farmers soon had large, painted houses and in general maintained attractive farm places. The immigrants from Georgia, on the other hand, built houses of unfinished lumber or of logs and made little attempt to render their farm places attractive. To this day many of them retain the practice of

sweeping the yard, in which not a spear of grass is permitted to grow. The German farm homes are usually surrounded by Bermuda grass, and shrubs are not uncommon.

In 1930, 91 per cent of the Germans were either full or part owners of the land they operated, whereas only about 50 per cent of the farmers in the county were full or part owners. A local banker reported that nearly all the Germans operate their farms on a cash basis (though many farms are now mortgaged) whereas nearly all of the cotton farmers operate their farms on a credit basis. A marked difference in working programs also exists. Whereas the cotton farmer spends much time in idleness during various periods of the year, the farmer with more diversified crops finds plenty of work throughout the year.

The significance of the unlike farming programs is clearly shown by the relief records of Cullman County. The county has a population of about 45,000, and of these it is estimated that about 2,500 are of German extraction. During the height of the relief program in the county, over 3,000 families were getting some form of aid. Persons closely connected with the relief program, however, could not recall that relief was being or had been extended to more than a few German families, and in these chronic illness was responsible for the need.

Baldwin County, Alabama

Baldwin County, Alabama, located on the Gulf of Mexico, has in the last few decades become one of the most interesting exhibits of diverse rural cultural groups in this country. These groups include Germans, Greeks, Scandinavians, Italians, French, and Poles. Prior to the arrival of these immigrant groups, around 1900, the county was sparsely settled by poor whites, who subsisted by marketing some forest products and a few cattle which roamed the forests. Life was extremely retarded and elemental. After a lumber company had cleared the land, real estate promotion schemes were set in operation and the cultural groups mentioned above were attracted.

Early potatoes and vegetables and citrus fruits promised large returns, and a decade or two ago small fortunes were made in a short time. Cold waves and frosts, however, soon ruined the prospects for fruit culture. In recent years the production of early vegetables has spread all along the Gulf Coast and competition has become keen—ruinous, some say. The sandy soils in Baldwin County require much commercial fertilizer and production costs remain high while prices for products frequently drop to distressingly low levels. Centers with lower fertilizer costs, such as the Rio Grande Valley of Texas, have a cost advantage in the production of similar early products. In recent years farmers in Baldwin County have diversified their crops more, obtained more stock, and developed winter pastures and pecan orchards. This diversification, it seems, should contribute greatly to a stabilized income. While the immigrant groups have brought about some remarkable developments in Baldwin County, judgment on their success must be qualified with an unknown, namely, how much capital they imported and what part it played in developing the many attractive farm places found in the county.

It seems that some of the most progressive farmers in Baldwin County are Italians. All of the immigrant cultural groups (nearly all of them came from or via the North), however, differ sharply in their farming practices from the rather inactive and unprogressive

natives. Agricultural experts in the Alabama Polytechnic Institute (at Auburn) point out that the most progressive farming in the state of Alabama is carried on in Baldwin and Cullman counties. It is interesting to note that in both of these counties the farming practices were revolutionized by non-Southerners and that both counties rank among the poorest in the state in native soil fertility. In contrast to this stands the desolation of the Black Belt of Alabama. Here the boll weevil has ruined cotton and thus the farmers, although the soil ranks among the most fertile in the South and will produce almost anything. What, one wonders, would the Germans of Cullman County or any one of the immigrant groups of Baldwin County have accomplished on the rich soils of the Black Belt, had fate beckoned them to that area?

GLÜCKSTADT, MISSISSIPPI

Glückstadt, Mississippi, is really no place at all. A signboard carrying this name is located on the Illinois Central Railroad track about 12 miles north of Jackson. Nearby is a small settlement of Germans, about 12 families, who moved to Mississippi from the North—mainly Indiana and Illinois, it seems—shortly after 1900. They sold their farm property in the North and with the proceeds made a start in the South. Their buildings were, therefore, largely built with imported capital. To this day they stand in striking contrast to the more general farm places of the South. Proximity to Jackson has given these farmers an excellent opportunity for dairying. Along with this enterprise they engage in diversified farming. In general they have greatly improved worn-out, gullied cotton land.

The soils in the Glückstadt area are formed on loess and erode readily. Moreover, since this is a section of rather large, old cotton plantations, the land has had the "benefit" of many decades of tenant farming, farming devoted almost exclusively to cotton and corn. The system whereby "the owner farms hell out of the tenant and the tenant farms hell out of the land" has had its day and has left behind a scene of waste, carelessness, and tragedy. This picture is well impressed upon one's mind as he travels through the German settlement into the section of larger holdings farmed by Negro tenants. In the German settlement the fields are well arranged, fully fenced, and farmed with a considerable degree of thoroughness. Separated from these by a mere road in some places is a disorderly array of patches of cotton, patches of corn, and patches of weeds, shrubs, briars, brambles, and trees. Much of the uncultivated land is in the so-called "recovering" stage, while at the same time the cultivated patches are being invaded by gullies and waste land. The Negro shacks range all the way from ugly to hideous. Most of their occupants are inadequately equipped with cultural techniques as well as physical tools to do a good job of farming.

Worn out and wasted land is of course not limited to this section of the Cotton Belt. It is very general on slope lands given to the raising of tilled crops, such as cotton and corn. Much land is wasted by the rankest kind of carelessness. For instance, innumerable examples can be found of fields that are contracting by the gradual extension of marginal gullies. Again and again it was found that instead of filling these gullies or plowing around them, the miserable tenant plowed his fields almost at right angles to the upper extension of the encroaching gully and thus wasted a high percentage of the remaining good land. In the light of this practice it

seems strange indeed to read in the *Report on the Economic Conditions of the South* that on the relatively small operating units of the South, "A farmer . . . is forced to plant every foot of it in cash crops; he cannot spare an acre for soil restoring crops and pasture."

Hammond, Louisiana

Since this survey was largely limited to cultural groups in the South that have introduced and maintained some form of diversified farming, very little time was spent among the French in the southern part of Louisiana who are engaged chiefly in the raising of sugar cane. Moreover, since sugar cane can be raised in this country only under import restrictions, quotas, or subsidies, its culture does not represent a type of farming that should be much extended.

Louisiana could greatly extend its sugar cane acreage if the price of sugar would rise to a somewhat higher level. Politicians and even some academicians of the state are making every effort to bring this about by having importing quotas of sugar reduced. When a professor in the state university was asked how he reconciled his efforts on behalf of a protected cane sugar market with a surplus cotton economy market, he replied, "Son, this sugar business is a damned practical problem we have on our hands." In the summer of 1938, a number of candidates for national office in the South were advocating tariff protection for dairy products, textile goods, and other native industries and products. This is a strange development indeed. The South has had and does have a very real grievance against the North on the tariff issue. But the ideal seems to vanish as promptly as "practical problems" arise.

About 50 miles north of New Orleans lies Hammond, Louisiana, the center of a large Italian (South Italians) settlement in which early strawberries are produced. Little diversification is practiced.

About eight miles west of Hammond, Louisiana, is Albany, the center of a Hungarian settlement, also engaged in raising strawberries and some truck crops. These Hungarians, it is claimed, produce the best strawberries in the section.

The Hungarian settlement at Albany illustrates the opportunity provided by the South in recent times for poor, agricultural immigrants from Europe. Most of the Hungarians have come to this country since 1900. Nearly all of them had to earn money in this country to purchase their small farms. Many of them worked for lumber companies in the South. After the land now occupied by the settlement was cleared, the Hungarians purchased it for about $10.00 an acre. Today it is worth nearly ten times as much. Although these people have rather small holdings and their cash income is not large, they have neat, attractive homes and farm places, they live well on a self-sufficient basis, and they engage in much social life. They are not representative of the problem farmer of the South. These Hungarians still retain some of the quaint customs and practices of their country of origin. The sociologist would find them an extremely interesting community for study.

Louisiana and Arkansas Rice Sections

The significance of cultural conditioning in farming practices is well illustrated by the rice-growing sections of Louisiana (largely centered around Crowley) and Arkansas (centered around Stuttgart). Shortly before the turn of the century it was learned that these

prairie lands, underlain by a hardpan, were well suited for the production of rice. It was also learned that this cereal could be produced most economically with large machinery; consequently, the real estate men directed their land-selling efforts to the machine farmers of the Middle West. A typical answer to questions regarding the source of the rice farmers was: "We wanted men that could handle machinery, not Negroes." Hundreds were brought South, and many of them bought. The farmer of the Middle West could, by selling his holdings, command a substantial amount of cash. This made him an attractive customer. The fact that land in the South was cheap in comparison with the Middle West was interpreted to the benefit of the prospective customers.

Some of the rice-growing sections are settled by solid blocks of Middle Westerners, who have reproduced in the deep South a cultural landscape typical of the Middle West. They live in large, well-constructed, painted houses. They usually have substantial barns and other sheds, well-constructed and usually painted. Their lands are fenced. Much machinery is found on their places, and many of them keep a good deal of stock. Islands of Bohemians and Germans were found, but their homesteads and farming practices are not distinguishable from those of other Middle Westerners (the latter, of course, represent a mixture of these and other cultural groups).

ALEXANDRIA, LOUISIANA

The agricultural success of the Middle Western farmers in the rice-growing sections of the South stands in marked contrast to the experience of a large settlement of Bohemians at Kolin and Libuse, Louisiana, near Alexandria. Alexandria is located on the exceedingly fertile alluvial lands of the Red River. A very short distance east of this city there is a coarse, chalky, infertile soil, covered by pine trees until shortly before the World War. This land was partly occupied by wretched natives, who eked out an existence with a few scrawny cattle, a number of razorbacks, and little patches of corn, cotton, and a few vegetables. A lumber company which owned a large block of the land had cleared much of its holdings just prior to the World War. It resolved to develop the land, and with the aid of the Alexandria Chamber of Commerce and some real estate men in the Middle West (with the aid also of pictures taken of crops growing in the fertile valley!) about 150 Bohemian families were drawn from the North, many of them from Nebraska, Iowa, and Kansas. Most of them came during the period of the World War (1914 to about 1919) and were charged fancy, exceedingly fancy, prices for the land. It seems that the average price ranged between $12.00 and $60.00, whereas its former and real value did not exceed $3.00 an acre.

Various deceptive schemes were resorted to to interest these Bohemians in the new development. Some of them were brought South in the spring when the landscape was covered with grasses and, in general, looked promising. The inactive natives in their wretched homes were pointed to for what appeared to be an obvious lesson. They weren't busy; they had no stock, no tools, no fields. Surely the enterprising Bohemian would succeed, for he would do things differently! The sales program in the North was largely in the hands of men also of Bohemian extraction, who dwelt upon the merits of living in a settlement composed of countrymen. Land in the North was high; in the South it was cheap, and a

move meant that holdings could be enlarged, or that debts could be wiped out while a new farm was obtained for cash. Some of the farmers, after selling their holdings in the North, came South with $15,000 to $20,000 in cash. The homes and barns built on the new holdings with this money give a deceptive appearance of prosperity to the area.

It was soon learned that the farming practices of the Middle West did not bring Middle Western returns. Yields were extremely meager, even on land that had never been farmed before. Here was something the Middle Westerner could hardly understand. Manure was applied with confidence. It did not help much. For the first time in their lives these Bohemians had to familiarize themselves with commercial fertilizer. Even this did not last long in the coarse, porous soil. Nor was there an agency, upon their arrival, that could offer sound advice on agricultural practices. Even experiment stations had little if anything to offer. Agricultural specialists seem to be agreed that this land should never have been converted to farm land but should have remained in trees.

Some of the Bohemians moved back North, some moved to the fertile lowlands, some moved to town, and about half of them remained on their acquired farms. Those who remain raise some of the best seed oats grown in the South. They also produce peanuts, sweet and Irish potatoes, and corn and cotton. They are milking more and more cows and are trying to develop dairying. Their program of farming is highly diversified and they produce most of their food. Unlike the native farmers, few of them have been on relief. As one of these farmers put it, "We can stay off relief; that's about all." A prominent citizen in the city of Alexandria said, "If we would have settled them on the lowland, they would have taken the country."

The Bohemian settlement at Alexandria provides an excellent example of the tragic consequences that frequently follow from chamber of commerce types of promotion. In every home in the settlement visited the wife shed tears over the sad mistake the family made in leaving the Middle West. The most tragic single instance of a disillusioned farmer in the South was also found in southern Louisiana. This farmer had for years been an outstanding stock raiser in the Nashville Basin. By methods somewhat similar to those used on the Bohemians, he was persuaded to sell his fine farm and to move to Louisiana. He came with about $25,000 in cash and several carloads of stock and machinery. He soon learned that the pastures were no good, grains did not produce, and stock did not thrive. Failure seemed imminent. His wife divorced him, his children left him, his farm was lost, everything was lost. Today he may still be sitting (as he was in the summer of 1937) in a miserable little shack, in rags, and half—if not altogether—demented.

On the fertile alluvial lands near Alexandria, Louisiana, there is a settlement of Belgians. It seems that some of them came over prior to the Civil War and others have come since. In all, it is estimated, nearly 100 Belgian families came to this settlement. They have always diversified their crops more than have other farmers in the area. In addition to cotton and corn, they usually raise potatoes and truck crops. The latter also provide a varied diet for the family and play an important part in a "live at home" program. The Belgians have the reputation of being thrifty and most of them own their farms. Those who do not own

their farms rent for cash and with their thrift have usually succeeded to acquire some land. In this respect they differ sharply from other tenants in the area, who usually are and remain croppers. In recent years, croppers here as elsewhere in the South have presented a serious relief problem, whereas relief was almost nonexistent in the Belgian settlement.

TEXAS

The varied cultural groups in the empire of Texas cannot be covered in a hasty survey trip. Inquiry into the history of the state, however, reveals that Germans are the most conspicuous cultural group from abroad that settled in Texas in relatively early times. Large migrations of Germans came to this state during the 40's of the last century. Most of them settled in and slightly beyond the triangular section lying between Houston, Austin, and San Antonio. Fredericksburg and New Braunfels are particularly noted as German centers.

Frederick Law Olmsted was one of the first to give an interesting account of the Germans in Texas. He compared, or rather contrasted, their careful, precise farming methods with the careless, casual methods prevailing among the other pioneers of the state. He noticed, for instance, that "the greater variety of the crops which had been grown upon their allotments, and the more clean and complete tillage they had received contrasted favorably with the patches of corn-stubble, overgrown with crabgrass, which are usually the only gardens to be seen adjoining the cabins of the poor whites and slaves." Olmsted was pleased to see the Germans raise cotton, for it demonstrated to him that this crop could be produced with free labor. The early German settlers in Texas were opposed to the institution of slavery and few of them ever acquired slaves. Their opposition to slavery at the time of the Civil War brought them into difficulties and subjected them to many abuses. In this connection it is interesting to recall that the first formal action against the institution of slavery during colonial times was taken by the Germans of Germantown, Pennsylvania, in 1688. The Germans in South Carolina similarly were at first strongly opposed to slavery. In Missouri likewise it was largely the German element that turned the tide in favor of the Union cause.

Since Texas was the recipient of large settlements of careful German farmers but also received much greater numbers of non-diversifying cotton farmers, the state provides an extremely interesting opportunity for the study of the survival of cultural techniques in farming. While most of the German communities are located in southern Texas, good settlements for study extend up to the northern boundary of the state. German settlements to this day carry on a rather diversified form of agriculture. On comparable soil, traditional cotton farmers who have never raised much besides cotton and corn have reproduced a landscape similar to that prevailing in the older cotton states.

MORRILTON, ARKANSAS

Near Morrilton, Arkansas, there are several German settlements and one Italian (north Italians) settlement. Both groups provide interesting material for study, but the Italian settlement, located in the folded section of the Ouachita Mountains on soil that is sandy and essentially poor, made an especially favorable impression with reference to farming practices. In part this may be ascribed to the fact that this settlement is more recent than

the German communities and that improvements are consequently newer. The Italians, however, are also very enterprising and follow approved farming methods. They have demonstrated unusual ability to live well on a highly self-sufficient basis. On one farm the cellar contained over 1,500 quarts of canned foods, ranging from berries, preserves, and jellies to meats and vegetables. All of these foods had been produced on the farm. The cellar also contained various kinds of preserved meats as well as a liberal supply of home-made wine. Needless to say, there was no pellagra in the family.

Successful Individual Farmers in the South

In addition to immigrant groups, there are many individual immigrants in the South who are successful farmers. Background and training have played an important part in their present success. Many dairymen and truck farmers near large cities in the South, for instance, come from dairying and trucking centers abroad or in the North. Many of them function in a supervisory capacity on large farms.

One of the outstanding "immigrant" farmers in the South is L. A. Zimmerman, who lives near Marshall, North Carolina, in the Blue Ridge Mountains. He is well known to agricultural specialists in eastern Tennessee and western North Carolina. Mr. Zimmerman is frequently referred to as "the Dutchman" or "the German," although both he and his wife were born in Kansas. Both attended the college of agriculture in that state, but it is in the capacity of a Presbyterian missionary that Mr. Zimmerman came to North Carolina some 20-odd years ago. He located in one of the most backward sections of the state, a section noted for shootings, feuds, undernourishment (largely mis-nourishment), lack of sanitary conditions and practices, and wretched housing. The Bloody Laurel, a stream in the neighborhood, suggests events that are rather common here as well as elsewhere in the remote mountain areas.

Mr. Zimmerman soon learned that missionary work was as necessary in farming as in spiritual affairs. The prevailing patch farming was soil-mining at its worst. He therefore acquired a farm of about 100 acres in an experimentation and demonstration mission. Much of the land had a slope in excess of 20 per cent. Among other things, he acquired a deep, hideous gully that was rapidly destroying what little lowland soil the farm still possessed.

Mr. Zimmerman felt that erosion could be checked and even prevented. He tried contour plowing, but the heavy rains washed the furrows off the hills. He tried terraces of one kind and another, and the rains washed them off the hills. He tried strip farming, but narrow strips of grasses were inadequate. The strips of grass were widened, up to 25 feet in places, and these wide strips held the soil. Where the gully formerly was there is now a beautiful meadow. Agricultural experts who examined the water running off Mr. Zimmerman's farm during heavy rains found it clear.

Diversification and rotation are practiced on the Zimmerman farm. Only one-twelfth of the land is tilled. Manure and commercial fertilizers are applied to the grasses and hay crops. When a plot of grass is finally broken in a rotation program of farming, Mr. Zimmerman expects and usually gets 60 bushels or more of corn an acre. Other farmers in the area do well if they get 20.

Mr. Zimmerman's cash income from the farm is small, coming largely from a few acres of tobacco. Nevertheless, professional persons with substantial

incomes declare that Mr. and Mrs. Zimmerman with their seven children "eat better than most middle-class city people." Nearly all their food is produced on the farm. A great variety of fruits and vegetables are produced, consumed fresh in season and in canned form out of season. Mrs. Zimmerman has canned over 1,000 quarts of fruit alone in a single season. Milk, butter, and honey are available at every meal.

Mr. Zimmerman's program of farming requires much work. Every member of the family is assigned tasks which bring modest remuneration, and the tasks are rotated. The children are industrious, capable, and happy. There is adequate reading material in the house and the family is well read. Agricultural experts frankly admit that Mr. Zimmerman has taught them more about farming in his particular area than they have taught him.

Author's Note:—Early in 1937 I received a pre-doctoral field fellowship from the Social Science Research Council to study cultural-agricultural islands in the South. Preliminary to making a detailed study of one of these islands I made a reconnaissance survey to determine the number of such islands and to gain an impression of their significance. Time and means were limited. Only about five weeks were spent in a survey which extended from the Atlantic Coastal Plain to the Black Belt of Texas. In the main, the trip was confined to the old Cotton Belt and agricultural problem areas on its northern boundary. An attempt was made to seek out those islands which departed from the traditional agricultural pattern of the South and suggested potentialities in diversified farming. The sites of several grandiose schemes of settlement, however, were also visited.

The information, opinions, and impressions gained in the survey are recorded here. While it is not presumed that this report contains a complete inventory of all cultural-agricultural islands in the South which practice diversified agriculture, it is believed that the outstanding ones are included, particularly those east of the Mississippi River. All places suggested by university and college faculty members who were familiar with the geography and agriculture of the respective states were visited. Personal observations were augmented by information gathered from county agents, bankers, merchants, ministers, priests, farmers, academic persons, and others. It should be remembered, however, that only a very short stay in each of the island communities was possible and that no thorough investigations could be made during these short periods.

A detailed study of one of the cultural islands (not mentioned in this report) was published in June, 1940, by the Bureau of Agricultural Economics. It bears the title "The German-Swiss of Franklin County, Tennessee; A Study of the Significance of Cultural Considerations in Farming Enterprises." This study was also accepted as a Ph.D. thesis in geography by Columbia University. A report on the Germans in Cullman County, Alabama, will shortly be published by the Bureau.

BOOK REVIEWS

JONES, CLARENCE F. AND DARKENWALD, GORDON G. *Economic Geography.* xxii and 629 pages. The Macmillan Company, New York, 1941. Price $4.25.

For many years there has been a genuine need for a new American college text in systematic economic geography, a book based from beginning to end on a world-wide view of the facts of economic utilization of earth resources, one that would dwell neither on the elements of the natural environment nor organize the economic data about an environmental framework. This recent text fills the need in a highly satisfactory manner.

This survey of economic geography is based, according to the authors, on occupations rather than on commodities or regions. It is perhaps nearer the truth to say that the great occupations, such as farming and mining, furnish the general framework within which much attention is also given to both commodities and regions. The occupational approach provides a simple, effective structure which may be elaborated in any desired direction. This approach, moreover, helps to achieve the end which Vidal de la Blache held to be a prime objective of geography—to leave together the things that belong together—but is sufficientiy analytical to promote a clear grasp of the essentials.

The outline of the book, being somewhat distinctive, deserves attention. There are seven parts: The Field of Economic Geography; The Occupations of Hunting and Fishing; The Forest Industries; The Grazing Industries; The Occupation of Farming; The Occupation of Mining, and Transportation Facilities and Trade. This arrangement provides for a treatment that marches, that is somewhat cumulative, and that leads up to a climax theme. The introduction promises an interpretation of the geographic facts in terms of both natural and cultural conditions, an aim which is followed with consistency; but the concluding part is necessarily weakened by the present uncertain state of world trade. In falling back on the more permanent aspects, such as trade routes and regions, the authors have chosen a safe course but they have thereby sacrificed a fascinating though possibly ephemeral theme in neglecting the current impact of economic nationalism on the geography of the world.

This is a rich book. The wealth of materials published in recent years in this field has been freely used. Some selection has, accordingly, been a matter of necessity. Emphasis has been placed on phenomena of world-wide significance and of interest to the United States, and on facts of the contemporary landscape. Theories and historical antecedents have been given scant attention as a rule, and there are few leads into related phases of geography.

In so large an undertaking, it is not surprising that selection and treatment appear inadequate in places. Everywhere there is too much information for any reader who wants to get directly at the gist of the matter; at points the authors seem to have failed to resolve their own thinking (as on pages 37–38); and in many places we would gladly trade the space given to descriptive details for more about the genesis of the phenomena described. The problem of localization is too commonly given scant attention, as is the historical geography of particular commodities and occupations.

The very wealth of information presents something of an instructional problem. Successful use of the text will no doubt require emphasis on outlines and care to build up clear notions of world distributions. The failure to use occupational types which fit together in complete world coverage and the occasional shift from occupation to commodity and back again may confuse some students. It is regrettable, in this connection, that the authors did not choose to follow a complete scheme of agricultural types or regions.

Especially commendable is the focus of attention on the more lasting aspects of contemporary economic life. This result is achieved in part by the sparing use of statistics except in graphs and on maps. Photographs are numerous and well chosen. Maps are freely used, not only to show world and national distributions but also to portray type studies, though the failure to use an equal-area projection for the world maps detracts from the value of some of them. With the well-selected references at the end of each chapter, the book serves as a guide to literature and as an economic atlas as well as a generous source of reading.

Richly informative, centered directly on the great activities by which man has brought the various earth resources into use, this book has effectively closed a serious gap in recent geographical literature. It merits wide use as text and reference work.

J. R. WHITAKER

ACKERMAN, EDWARD A. *New England's Fishing Industry.* Published by The University of Chicago Press, 1941. Price $4.00.

From time to time a book appears from the press which bids fair to constitute a source of geographic material for decades to come; it is not too much to say that "New England's Fishing Industry" is just such a book. It has been needed by geographers, oceanographers, and the whole fishing industry for many decades past. It will not soon be superseded by another so basic a discussion of this very important locality in the fishing industry. It is an exhaustive and authentic study of a definite sea region

which has made an important contribution to the economic life of our whole country and which has furnished much of the original capital which has given New England its important part in the financial structure of our American business.

Written by an able and productive geographer, it represents the geographer's viewpoint, and the geographer's technique, in a most able and creditable manner. It is one of the few books, aside from the multitude of textbooks, which illustrates the geographer's discipline and exemplifies the strict scientific procedure he follows to come to his conclusions and to assemble his facts for the basis of his generalizations. In brief, it provides an excellent criterion of the geographer's usefulness to industry, to science, and to our economic life. The members of the geographic profession will be proud of the book as a fair example of their work.

Everyone who reads the book will be impressed by the restraint which the author has shown in selecting his material. He might easily, and in many cases justifiably, have included a great deal more material, of which there is a vast store at hand that would have been of general interest but not particularly relevant to the purpose of the book, nor generally geographic in its point of view. He has, however, selected his material with the very definite object in view of making it a truly representative and creditable geographic treatise, without digression into half a dozen related fields that would have increased the volume of fact relating to the New England fishing industry, but would not have improved the clear picture which the author evidently intended to give. As a consequence of his restraint, and careful selection of material, he has given us a book which includes every important aspect of the industry that can be reasonably considered geographic. It is a book which geographers, as well as many other scientists, will use for many years to come, and find of primary value, not only now but a half century hence.

The book is very well bound, is printed in clear type on excellent paper, and displays the same sound craftsmanship in its manufacture as the text does in its organization and presentation. It will long remain a valuable, almost indispensable reference book on the field which it covers.

W. E. E.

RAUP, HUGH M., AND CARLSON, REYNOLD E. *The History of Land Use in the Harvard Forest.* Harvard Forest Bulletin No. 20, Petersham, Massachusetts, 1941.

Much more significance than the staid and sober title would indicate, accrues to this very important publication from the Research Staff of the Harvard Forest in Petersham, Massachusetts. Though more historical than geographic, it is of primary interest to the many geographers who are now working in the fields of Land Economics and Land Utilization, as well as Planning and Conservation. Professor John D. Black designates it "A real pioneering effort in historical research, combining a field-by-field and farm-by-farm study of records of real estate transfer and land use, with an actual field-by-field study of the complete succession of land use covers, from the earliest use of the land down to date."

During one period, and this period was of considerable length, most of the land now included within the Harvard Forest was farmed. During the long period of subsistence farming in New England such land as the Harvard Forest now includes within its limits formed an important part of the hilltop farm establishment. As farming which was dominantly of subsistence type, gave way before competition of commercial agriculture of new and productive western lands, and farm labor found much more attraction both financially and socially in growing manufacturing communities then developing in many parts of New England, the subsistence farms were abandoned. They reverted to forest as dense and exclusive as were the primeval forests through which the Indians hunted and which they burned occasionally when dry seasons permitted, to improve their kill of game, and which the early settlers had to fell wherever the trees still grew when they occupied the Massachusetts Central Upland. The Harvard Forest, until the hurricane of 1938 destroyed its continuity and superiority of stand, formed one of the chief attractions for tourists and visitors from all parts of the country, because of its pristine character and attractiveness.

The authors of the Bulletin are an ecologist in the Department of Biology at Harvard and an economic historian, who cooperated in doing the careful research that was necessary. They were aided by economists, geographers, sociologists, geologists, conservationists, foresters, and many others interested in the problems entailed in the study as well as in the Harvard Forest itself.

The book will prove of value to students in all branches of social science, not only because of its subject matter, but because it presents a technique which may be adopted for many similar studies, and because the subject with which it deals is fraught with significance in so many current problems before our American people.

W. E. E.

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Broomcorn Industry of Coles County, Illinois, Louise M. Trager, 424 Diversey, Chicago, Illinois.
Evolution of the Irish Railway System, Charles A. Fisher, in service with the British Army.
Current Trends in California Orchards and Vineyards, Peveril Meigs, III, State College, Chico, California.
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Industrial Geography of Lower Wabash Valley, Alden D. Cutshall, University of Illinois, Urbana, Illinois.
Urban Growth in the San Diego Region, Nicholas Mirkowich, University of California, Berkeley, California.
Tacoma, Lumber Metropolis, Gertrude L. McKean, Clark University, Worcester, Massachusetts.

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Ribe, W. R. Mead, Aylesbury, Bucks, England.
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